THURSDAY, DECEMBER 21, 1893.

THE TOMBS AT BENI HASAN.

Beni Hasan. Part I. (Published under the auspices of the Egypt Exploration Fund.) By P. E. Newberry and G. W. Fraser. (London: Kegan Paul, 1893.)

IN the handsome volume which lies before us the Egypt Exploration Fund publishes the first part of an "Archæological Survey of Egypt," which it proposes to issue under the direction of Mr. F. L. Griffith; and we believe that it will be generally admitted the site selected for description and illustration in the first part of the projected work could not have been better chosen. We are also very glad to see that the committee has changed the scene of its excavations from Lower to Upper Egypt, for there it is moderately certain that excellent results will accrue to the archæologist and Egyptologist. It must not be thought for a moment that we wish to underrate the value of the excavations which the Fund has made in the Delta, but it must be said that in the days, now past we hope, when sentimental Egyptology was more rampant than it is now, too much time and money were spent in the endeavour to bring to light "proofs" of the truth of the Bible narrative which could not exist, and in twisting evidence to suit the fancies of enthusiastic *dilettanti*. We admit that in the Delta these things are "in the air," for the land of Goshen lieth there, and the sites at which the Israelites are supposed to have halted must be sought therein, and the *yam sûph*, or "sea of reeds," must border it in some part; but in Upper Egypt we are face to face with the mighty monuments of some of the best periods of Egyptian art and sculpture, and we are free from the influence of the heterogeneous mixture of peoples in the Delta, and in the everlasting hills which fringe the banks of old Nile we have the remains of a nation which could boast of a hoary antiquity, even before Joseph came into Egypt. The spot chosen for the new scene of labour by the Egypt Exploration Fund is Beni Hasan, probably better known as Jebel Beni Hasan, which forms a link in the long chain of cliffs which bound the eastern side of the Nile valley, and for which we may look on the map between Minyeh and Roda, a little more than 150 miles south of Cairo. Here, high up in the rock, are hewn two ranges of tombs, which are approached by a sloping path, at the top of which is a terrace whereon all the large tombs open. Of the thirty-nine tombs at Beni Hasan, twelve are inscribed, and of these eight are of governors of the nome wherein they are situated; two are of princes, one is of the son of a prince, and one is of a royal scribe. In one range—the northern—are thirteen tombs, and in the southern are twenty-six. Speaking broadly, it may be said that both ranges were hewn during the twelfth dynasty, or about B.C. 25 0. Of the twelve inscribed tombs six may be dated with a fair amount of accuracy; one (No. 14) bears the name of Amenemhāt I., and another was probably hewn at the end of his reign; No. 2 belongs to the reign of Usertsen I., and Nos. 3, 4, and 23 we must place in the reign of Usertsen II. Concerning the remaining six, we need have little doubt as to their age, for the position of some of them indicates that they belong to the period anterior to the reign of Amenemhāt I.

Considered historically, the tombs of Ameni-Amenemhāt and Khnemu-hetep are of the greatest importance, for they afford us some insight into the life of high officials in those days, and incidentally record some interesting historical facts. In the reign of Usertsen I. Ameni held the high rank of hereditary prince, and he was chosen by his royal master to make three expeditions into Nubia and Ethiopia; on the first occasion he accompanied his king; on the second he set out with the royal heir at the head of four hundred men, and brought back the appointed tribute; and on the third, he marched at the head of six hundred men. In quaint, characteristic language this worthy nobleman paints his own character, and says: "I wronged not the daughter of a poor man, I oppressed not the widow woman. I was not hostile to any farmer, I stood not in the way of the cattle-keeper, I levied no men for my works, there was no beggar round about, neither felt any man hunger in my days. In the season of famine I ploughed the land of the nome, north and south, I saved the life of its people, and I provided food, so that there was no man hungry therein. I gave to the widow the same as to the married woman, and in this respect I treated the younger as the eldest son. When, in after years, there were abundant Niles, and wheat and barley were plentiful, I did not claim payment for what I had given in the previous years." The most interesting text in the book, however, is that in which Khnemu-hetep, a feudal chief, records the chief events of his life, and the high services which he had rendered to his king. He was the son of Nekhera, and of the daughter of a princess called Baket, and he held the office of governor of the Arabian desert, and *utcheb* priest of Horus and Pakhet; the king, Amenemhāt II., granted unto him the inheritance of his father and mother in Menāt-Khufu, and his property lay on each bank of an arm of the Nile, or of that river itself. As a landowner, he gave great attention to the adjustment of the boundaries of each city in the nome, and his fair and upright dealing in this respect gained him great favour in the sight of all men. The king promoted him over the heads of all his nobles, and conferred favour after favour upon him; his sons, Necht and Khnemu-hetep, who had been born to him by the lady Khati, were each raised to the rank of *Smer uat.* Following the example of his father Nekhera, the son of Sebak-ānkh, who from his earliest childhood had held the highest place in the king's favour, Amenemhāt built a tomb, upon which are his own name, and that of his father, and it is to the inscription which he caused to be engraved upon it, under the direction of the architect Baqet, that we owe our knowledge of the life and times of this trusted official. The hieroglyphic text of the inscription has been published several times, but Mr. Newberry has succeeded in correcting several errors, one of the most important being in line 12. There is no doubt that this edition of the text is the best hitherto published. But hieroglyphic texts are, in the main, only useful for Egyptologists, and they form, after all, but a very small part of the book, which owes its chief attraction to the large number of beautiful plates which are in it. In these we

find depicted representations of all the chief scenes which are found in the first fourteen of the tombs that form the subject of the part before us, and it would be difficult to speak too highly of their excellence. The reader who has seen the originals will have them brought again vividly before his mind, and he who has not seen them may rest content that he has under his eyes faithful copies of the paintings reproduced in soft and pleasing tints. The subjects for the coloured plates are well chosen, and we believe that they will be generally admired. Altogether, the life of what we might describe as an "Egyptian feudal baron," enjoying high favour with the king, is most thoroughly depicted; the periodic war waged against the blacks in the gold-producing countries, the chase, to keep the body sound and the limbs supple, and the keen personal superintendence of all agricultural operations, whereby the evil results of "absentee landlordism" was done away with, filled the life of these old lords of the soil, who fondly hoped to live in the next world as they lived in this. When we consider the state and luxury in which they lived, and the large households which they maintained, it is not difficult to understand why Egypt was always an object of plunder by neighbouring nations.

Before we end our brief notice of this most interesting book, we must call attention to the hideous system of transliteration which has been adopted throughout; but we are wrong in calling it "transliteration," for that is intended to help the poor reader, who is not an expert, how to pronounce; but this is not, and is only meant to indicate what Mr. Griffith imagines to be the proper way of representing Egyptian characters in English letters. Studies in systems of transliterations are excellent gymnastics for experts, but the non-expert resents the constant changes which are being thrust upon him; and no surer plan of alienating the interest of the general public can be found than that of setting out in a work which is paid for by the general public, and is meant for all readers, a system representing hieroglyphics in English letters, which is both unnecessary and difficult; moreover, we submit that the transliteration which Birch and Lepsius formulated is easy, and at the same time sufficiently correct for all practical purposes.

A NATURE LOVER'S CORRESPONDENCE.

Letters to Marco. By George D. Leslie, author of "Our River." (London: Macmillan and Co., 1893.)

MR. LESLIE has published a good book with an unpromising title. It contains thirty-seven letters written to an old friend, H. Stacy Marks, R.A. The first of these is dated October 4, 1885; the last, March 6, 1893.

Both the author and his friend have attained to eminence as painters, but there is no word in the book which alludes to their professional careers; and but for an occasional grumble that a picture is not going smoothly, no one would guess that the letters were written from one artist to another.

The interest of the correspondence centres upon mutual associations connected with the banks of the Thames, where they wandered together in days gone by, observing nature, sketching her, and nourishing their youth with aspirations, many of which they have lived to realise.

That was in very early days, when name and fame were still behind the clouds of morning, and when they used to leave London annually with the expressed intention of "improving the quality of the British kit-cat," which was still in an unregenerate condition.

As the interest of an artist's career lies in his struggles, and as the annals of success make commonplace reading, we can be grateful that all allusion to professional matters has been left out, though we might have been glad to have more artistic observations, such as that of the black rook flying away with a golden walnut in his mouth.

One palpable realised ambition is the pretty property which Mr. Leslie has bought at Wallingford, from which he writes to his old friend, describing the condition of their old haunts, and chatting in a desultory way about nature in general.

As Mr. Marks is an ornithologist, there is a great deal about birds. He observes their ways, and describes the kingfisher hovering over the water, the terns hawking on the shallows, and the poor swallows during a frost cuddling up together to keep warm; and what is a great comfort, he kills nothing. He is not a sportsman, and not being a naturalist he does not want specimens for dissection; he merely observes with loving watchfulness; in hard winters he scatters food to mitigate the lot of his feathered friends, and it is absolute grief to him when his children bring a poor fledgling which they have captured. This is the great charm of his book, which probably adds little or nothing to our knowledge of natural history; indeed, its method is the reverse of scientific, and its originality consists in the persistent way in which the author discerns human attributes in birds. They are to him a little people, whose customs and ways of thinking he studies attentively. The robin comes to him to sing a "conciliating song," the blackbird is "proud, vain, and impudent," and the sparrow is "bold, but he knows that he is only tolerated"; and these things are evidently not stated with any conscious or intentional metaphor, but in perfect good faith. The author, in fact, is an amiable enthusiast, who loves nature with his whole soul; and when the contemplation of birds, beasts, flowers, and fruit has worked him up to a state of enthusiasm, rushes home and writes to his friend to tell him what he thinks about them.

We do not feel in a position to dispute the theories which he occasionally propounds, such as that the young shoots on a hedge are kept in their place and supported by cobwebs, that darkness is favourable to the growth of plants and babies; on all these matters he speaks with more authority than we can pretend to. All we can venture to say is, that "si non e vero e ben trovato"; and his theory of darkness seems to explain the unfolding of a sycamore shoot, though he gives no instance of its operation in the case of the young of the human species.

The contemplation of all things in nature—birds, beasts, and fishes, reptiles, insects, and molluscs, inflames Mr. Leslie to a rapture of affection; and when the fit is on him, he can find extenuation even for snails and sparrows, whereby he soars into a lofty and rarified region of

charity and benevolence, into which we find it impossible to follow him.

There are many amusing descriptions and playful passages scattered through the book, such as the friendship of the donkey and the dirty drake who disliked cold water; and the droppings of the reindeer, which the author spread round his Iceland poppies because he thought it might amuse them; and it is also very pleasant reading on account of its evident sincerity and absence of affectation, of which the following is a fair example.

The author describes the snails in his garden: "the common 'tabbies,'" he says, "have already begun to hibernate, but the bushes are covered with a small flat kind." A less conscientious and more pretentious writer would inevitably have made a shot at their generic and specific names, and given us the words "Helix aspersa" and "Helix nemoralis" in brackets; but Mr. Leslie very wisely makes no pretensions to be considered a naturalist, though he knows more of the aspect of organic life than many an authority on comparative anatomy; his knowledge is that of Götz von Berlichingen, who "knew every pass, pathway, and ford about the place, before he knew the name of village, castle, or river," and he seems thoroughly to sympathise with the sentiments of Shakespeare's "Biron":—

> These earthly godfathers of heav'n's lights
> That give a name to every fixed star,
> Have no more profit of their shining nights
> Than those that walk and wot not what they are.

The accuracy of Mr. Leslie's observation is shown by the illustrations which he has scattered through the volume; some of these are extremely beautiful, such as the "Bird's-eye View of a Swallow," "The Fruit of Rosa Rugosa," and "Flight of Starlings and Rooks," as is also the frontispiece, representing his house at Wallingford.

This book we can confidently recommend for its tonic properties. To the great world of men and women given over to satiety and boredom it cannot but be salutary, by pointing out what a world of enjoyment, what a peaceful and engrossing occupation for leisure, lies open to all of us, outside our own doors, and the only price we have to pay for it is to take the trouble to use our eyes.

OUR BOOK SHELF.

A Text-book of Heat. The Tutorial Physics, vol. ii (Univ. Corr. Coll. Tutorial Series.) By R. Wallace Stewart. (London: W. B. Clive, 1893.)

NOT long ago we had occasion to say a few words about the books which have appeared from the pen of this author, and we then stated our belief in him as a writer whose clearness of explanation and conciseness of language would render him popular among students of physics. In the volume now before us, which is devoted simply to the one branch of this large subject of physics—heat—we may again apply the same remarks to the treatment of the subject, the author stating with all clearness and necessary accuracy the various laws, and showing their practical application by means of appropriate examples. In the descriptions of the experiments, as, for instance, in those for determining the absolute expansion of mercury, the object of the experiment in question, the end to be obtained, and the different means of attaining it, are especially emphasised, and the diagrams aid the reader in grasping a clear idea of the arrangement of the apparatus employed. At the end of each chapter, under the heading "calculations," are brought together all the formulated expressions of the laws deduced in the one preceding—a very useful arrangement for a short revision of the subject. The concluding chapter deals with the application of graphic methods to the results of experiment, and this part of the subject is one of great importance, although generally omitted in text-books. The work, as will have been noticed from the heading, is published in the Tutorial Series, and is a most useful addition to it.

The Industries of Animals. By Frédéric Houssay. (London: Walter Scott, Ltd., 1893.)

THIS—the twenty-third volume of the Contemporary Science Series—is an English edition of a good book. It is not merely a translation, but a revised and enlarged edition, to which numerous bibliographical references have been added. By this addition the work has gained considerably in value; for such references are not only useful to the student who desires to increase his knowledge of any matter broached in the book, but they also furnish a means of estimating the weight of the many stories of animal intelligence and instinct contained in it. The first chapters of the book deal with those industries of animals of which the object is the search for prey. These industries are necessarily connected with protective effects providing for the immediate safety of the individual. A number of examples are then given, to show that "social species unite for the common security the forces and effects which they can derive from their own organs." The art among animals of collecting provisions, of domesticating and exploiting flocks, and of reducing their fellows to slavery, is well described, and, finally, the series of modifications which the dwelling undergoes is investigated.

Except in one or two places, the translation reads very well. Forty-four figures illustrate the text, most of them adapted from that great repository of facts in natural history—Brehm's *Thierleben*. Altogether the book is very pleasant reading, and it contains a large amount of matter of interest to all students of animal skill and intelligence.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

"Flame."

IN NATURE for November 23, p. 86, under this title, there appears an account of a lecture delivered by Prof. Smithells to the British Association on September 15, in which he brings before the Association those fascinating experiments with which his name has lately become identified. The apparatus by means of which Prof. Smithells draws the "inner cone" of a flame away from the "outer cone," and which he describes as *an appliance for dissecting the flame*, or *the cone-separating apparatus*, is now quite familiar to most. By means of it a regulated stream of air is admitted along with the burning gas, until a portion of the flame recedes down the tube, and is arrested in its downward movement at the top of an inner tube, where the issuing gases are moving upwards at a slightly greater rate.

In all cases Prof. Smithells calls this descending flame the *inner cone*, and regards the remnant of the flame that remains at the top as the *outer cone*. It would appear to follow, therefore, that if, by means of the "cone-separator," a flame can be so dissected, it must have originally consisted of two cones.

Prof. Smithell describes the flames of hydrogen and of carbon monoxide as being of the simplest construction; it being out of the question that any complications can arise in the combustion of hydrogen to water, and of carbon monoxide to

carbon dioxide. These flames are therefore described by him as being "simply a hollow conical sheath of pretty uniform character." This is undoubtedly a true description; neither of these flames presents the appearance of double-coned structure which is seen in such flames as cyanogen, carbon disulphide, ammonia, and others; and it is hardly possible that in a hydrogen or carbon monoxide flame there can be two distinct areas or cones in which different chemical processes are going on. It occurred to me that it might throw some light upon the real value of this cone-separating apparatus as an appliance for dissecting flames, to try its effect upon the single-coned flames of carbon monoxide and of hydrogen. When air was cautiously admitted into these gases, as they burned at the top of the tube, I found that the flame travelled quickly right down the tube, and did not stop at the narrower tube when the upward rate of movement was greater, and did not appear to leave any remnant at the top of the wider tube. I have no doubt but that Prof. Smithells has made this experiment, and with a similar result.

I have found, however, that by a slight modification of the apparatus, it is quite easy to drag down an inner flame from either the flame of carbon monoxide or of hydrogen. In order to do this, all that is necessary is to provide the top of the inner and narrower tube with a cap made of fine wire gauze, either copper or platinum. When this small addition to the original apparatus is made, and the experiment with carbon monoxide is repeated, it will be seen that as air is gradually introduced a portion of the flame descends the tube and sits quietly upon the wire gauze, and, in spite of the flame-extinguishing power of the carbon dioxide, it there generates, a remnant of the original flame remains feebly burning at the top. In the case of hydrogen a similar result is obtained, a portion of the flame descending to the gauze, where it burns with a pale blueish flame, while the remnant burns freely at the top. These experiments show that whatever is the structure of the flame, a part of it can be torn away from the rest by the regulated introduction of air: that in order to divide a flame by this method it is *not* a necessary condition that the flame should consist of more than one "cone," or, in other words, that there should be two distinct areas of combustion. If, therefore, a "simple" flame like that of hydrogen, consisting of a single cone of uniform character, can be divided, the fact that other and more complex flames can also be so divided, does not seem to throw much light upon their structure. As soon as sufficient air has been admitted into a flame, of whatever burning gas, to produce a certain volume of an explosive mixture whose rate of explosion exceeds the rate of efflux of the gases, that exploding mixture will become detached from the remainder of the burning gas, and travel back down the tube. In the case of hydrogen, where a very wide margin exists within which mixtures of this gas and air are rapidly explosive, the admission of a very small quantity of air is sufficent to form such a mixture, and so drag down a comparatively small portion of the entire flame. In the space between these two flames there can only be water vapour as the product of combustion, atmospheric nitrogen, and the excess of hydrogen. The lower flame is a burning mixture of air and hydrogen in which an excess of air is taking part in the combustion, and represents a condition of things certainly not far removed from, if not identical with, the old phenomenon of air burning in hydrogen. It is difficult to see in what way the separation of other flames differs from this.

I have no doubt that everyone who has read the account of Prof. Smithell's lecture will have been struck, as Dr. Armstrong was, with the manner in which the classical researches of Dr. Frankland are brushed aside, and the difficult question as to the true causes of the luminosity of flame is settled by an appeal to the "opinion of the majority."

Without touching the question as to whether or not solid carbon is actually precipitated during the decompositions that are going on in a coal-gas flame, the recent experiments of Prof. Lewes leave no room for doubt that the first stage in the process of decomposition and condensation that goes on, is the production of acetylene, which is formed during the passage of the gas through the inner dark area of the flame, where no combustion is going on; that is to say, where the hydrocarbons are being simply strongly heated, but are not burning. This fact seems to have an interesting bearing upon some of the peculiarities exhibited by the well-known flame of air burning in an atmosphere of coal-gas. In this flame the air is in the inside, and the hydrocarbons upon the outside; it is in effect an ordinary coal-gas flame *turned inside out*. The formation of acetylene, instead of taking place within the flame, as in the usual conditions, in which case it has to pass through the heated area where it is further decomposed with probably the precipitation of carbon, is now produced upon the outer surface or periphery of the flame; it therefore largely escapes combustion or decomposition, and passes into the coal-gas atmosphere with which the flame is enveloped. Hence the flame is non-luminous, and hence also this constitutes the ready method for obtaining large quantities of acetylene first devised by Prof. McLeod. I am not aware that it has ever been noticed that during the combustion of this non-luminous flame there are produced, besides acetylene, other hydrocarbons of much greater density. That this is so is evident from the fact that when the flame has been allowed to continue burning for a length of time, the glass vessel in which it is contained becomes coated with a brown tarry film. This non-luminous flame of air burning in coal-gas can be rendered luminous by a simple device. If the vessel employed in which to burn it be an ordinary bulb-shaped paraffin lamp chimney, it will be seen that when the flame is in the middle and wide portion of the chimney it is non-luminous; if, however, it be thrust up into the narrow part, it at once shows signs of luminosity: the acetylene under these circumstances is reflected back into the flame, which, aided no doubt by the radiated heat from the glass, causes the luminosity. If the supply of air be regulated, the flame may be caused to curl over upon itself, whereby very beautiful vortices are obtained, in which Heumann's floating particles are well seen. There is an old experiment in which two flames of air in coal-gas are placed side by side, and so arranged that at will they can be caused just to impinge upon each other. At the point where they touch a small luminous area is seen to appear, the luminosity being probably due to the same causes.

G. S. NEWTH.

I AM unable to understand how Prof. Smithells can in any way suppose that I either have, or possibly could, cast any imputation on his honesty, "scientific" or otherwise; and I fail also to understand what has given rise to the impression, unless it be that the opening sentence of my letter—which I intended should convey a compliment—has been turned round and a meaning given to it which I never contemplated, and which it cannot fairly be made to bear.

I have always regarded NATURE as a journal which is willing to afford a fair field for the consideration of scientific problems, but the last place in which to raise, let alone discuss, personal questions. By publishing his lecture in NATURE, Prof. Smithells directly challenged criticism, and the only object and intention of my letter was to challenge the validity of certain of his arguments. That he should have taken the view he has, is to me a matter of deep regret. He has now stated his position very clearly, and the passage that he has been good enough to quote from my letter to Sir G. G. Stokes sufficiently defines mine. I fear that we must agree still to differ; evidently we look at these matters from very dissimilar standpoints.

HENRY E. ARMSTRONG.

The Postal Transmission of Natural History Specimens.

AT page 100, *ante*, you reproduce a circular letter, sent out by the Academy of Natural Sciences of Philadelphia, on this subject, the object of which is the very laudable one of establishing an international rate of postage for natural history specimens, based on that charged for *bona fide* trade patterns and samples. It is therein stated that the United States Post Office Department recently proposed to the countries comprised within the Postal Union a modification of the rates in favour of a charge so based, but that the Governments of very many of them declined to consider the proposal, and in the list there given Great Britain is included. No precise date for this refusal on the part of the British postal authorities is given, but presumably the date is not precisely recent. Early in 1891, several of our Natural History Societies agreed to approach the British postal authorities on this point, and a letter was addressed to the Secretary of the Post Office (the late Sir S. A. Blackwood) by Lord Walsingham, on March 18, 1891. A reply (which I have before me) to that letter, from Sir S. A. Blackwood, is dated April 13, 1891, and is published in the Proceedings of the Entomological Society of London, 1891, p. 14 (and probably elsewhere). An extract from the letter is to this effect:—"Your

lordship will no doubt be glad to learn that so far as this Department is concerned, scientific specimens sent by sample post, and addressed to places abroad, will not be stopped in future; but I must state that this Department cannot guarantee the delivery of such specimens abroad, inasmuch as they do not come within the definition of sample packets as prescribed by the Postal Union." I may add that within the last month I have, on two occasions, sent specimens abroad by sample post with perfectly satisfactory results.

All naturalists will feel grateful to the Academy of Natural Sciences of Philadelphia for agitating in this matter. But it is to be regretted that the United States Postal Department should, in another way, continue to maintain a barrier against cheap transmission and interchange of specimens. The sample post can, in any case, only be used for small packets, but larger packages can now be sent to nearly all foreign countries by parcel post, the introduction of which was an inestimable boon. The United States Government stands almost alone in persistently refusing to co-operate in this respect. It is not for scientific men to inquire into what contracts that Government may have entered into with private carrying companies, or how far it may be influenced by hyper-protective susceptibilities; they can only regret the facts, and deplore the result.

Lewisham, December 8. R. MCLACHLAN.

"Geology in Nubibus."—Mr. Deeley and Dr. Wallace.

MR. DEELEY will not have anything to say to ice conveying thrust *as a solid body*, which has been the sheet anchor of glacial geology for many a decade. He also repudiates Dr. Wallace's notion that regelation can in some way act as a compensating element when crushing supervenes in ice, and thus enable it under crushing pressure to convey thrust. So far so good.

Mr. Deeley, however, bids me turn to ice acting as a viscous body, a subject on which I have written a great deal in my recent book, which he does not seem to have seen.

There are two ways in which we can conceive a viscous body flowing on a flat plain: (1) by pure fluid, or what is commonly called hydrostatical pressure, in which the upper layers move up and down, and the lower layers alone have a horizontal motion; (2) by its particles rolling over each other. The former depends, of course, entirely upon the difference of level of two connected parts of the mass under consideration; the latter depends upon the slope of the upper surface of the fluid.

I contend, as Forbes contended, that in the case of a body so slightly fluid as ice, motion by hydrostatic pressure is practically impossible. The consistency and mutual support of the parts prevent the indefinite transmission of pressure in this way through ice, and nowhere have I seen or heard that in detached masses of a glacier cut off at either end by crevasses the ice rises in one place, and sinks in another, or that the walls of these ice rifts or the perpendicular ice walls in the arctic and antarctic regions or in scarped icebergs bulge out below in the slightest degree, as must happen if ice were to move in this method.

Forbes' experiments and measurements and patient examination of the problem proved that ice as a viscous body moves in fact by its layers rolling over each other, and that this motion is differential, being greatest at the surface and in the middle, and least at the base and sides of a glacier.

It is quite true that the rate of this motion on a flat plain would depend theoretically on the slope of the upper surface of the ice. It is established by experiment, however, that such motion is very largely confined to the surface layers, and when we approach the nether layers the motion quickly slackens, owing to the internal friction and drag of the ice particles. Even on inclined beds, glaciers have sometimes been found frozen to the ground. The evidence of a large number of observers is conclusive, that as glaciers reach the level ground, the motion, even of their upper layers, gradually stops. The masses of ice that collect on the flat Siberian Tundras do not move at all, nor do the thick horizontal ice beds examined by Dall in Alaska. Argument, experiment, and observation are therefore entirely against Mr. Deeley, upon whom the burden of proof rests. Perhaps he will explain what are the conditions under which he conceives his ice sheets to have been formed, to have been maintained, and to have moved. Mr. Wallace confesses that he does not like to face these mechanical issues, which are presupposed in all his reasoning. This is assuredly building on a quicksand, which is not a profitable experiment. He cannot be serious, either, in arguing that because I believe in Charpentier's view that the Alps were formerly higher, and consequently nursed bigger glaciers, I am therefore committed to Ramsay's extravagant notions, repudiated by nearly all explorers of glaciers, that the lakes of Geneva and Lucerne were dug out by ice. Charpentier's method, in such a case, would have prompted him to first prove the capacity of ice to do the work, and most people will agree that in a scientific argument this method is alone fruitful. H. H. HOWORTH.

30 Collingham Place, Earls Court.

The Viscous Motion of Ice.

Is not Sir H. Howorth wrong in assuming that there is no transmission of hydrostatic pressure in ice? Certainly Forbes was of opinion that such transmission existed, and was necessary to explain the remarkable parallelism between the motion of ice and of viscous fluids. It is a question of scale. Even a cup of treacle will not flatten out indefinitely; still less will a barrel of pitch; but I have no doubt a cubic mile of ice would flatten out, but to what extent is a question for calculation, not for dogmatic assertion. Unfortunately the first requisite of such calculations is wanting, as no determination of the coefficient of viscosity exists. Canon Moseley's experiments are clearly out of court, and in the interesting experiments of Mr. Coutts Trotter in 1883, the length of the portion of ice which took part in the shearing motion is not given.

May I add that the paragraph in Sir H. Howorth's letter of November 23, in answer to Mr. LaTouche, is distinctly erroneous so far as our limited evidence goes.

If Sir H. Howorth will draw to scale the observations of Prof. Tyndall at the Tacul on the side of the Mer de Glace, or those of Prof. Forbes, given on page 554 of his own book, he will see that while the velocity of the ice is greatest at the surface, the viscous yielding or differential motion is greatest at the bottom; and the curve into which a vertical line in the ice is thrown by the motion, is always convex towards the direction of motion, is relatively flat above, and strongly curved towards the base. This is exactly what we should expect on the viscous hypothesis, and justifies the application of hydrodynamical treatment to the problem, if only the necessary data were to hand.

29 The Boltons, S.W. JOHN TENNANT.
December 12.

Chemistry in Space.

IT may be of interest to your readers to know that the idea of the arrangement of atoms in space, which is looked upon as quite a modern one, is clearly put forth by Wollaston in his paper entitled "On Super-Acid and Sub-Acid Salts" (Phil. Trans. vol. xcviii. 1808, pp. 96–102).

He discusses the constitution of the two oxalates of potash; and I make the following extracts, but must refer your readers to the original paper for the full context. . . . "when our views are sufficiently extended, to enable us to reason with precision concerning the proportions of elementary atoms, we shall find the arithmetical relation alone will not be sufficient to explain their mutual action, and that we shall be obliged to acquire a geometrical conception of their relative arrangement in all the three dimensions of solid extension. . . . when the number of one set of particles (combined with one particle), exceeds in the proportion of four to one, then, on the contrary, a stable equilibrium may again take place, if the four particles are situated at the angles of the four equilateral triangles composing a regular tetrahedron. . . . It is perhaps too much to hope, that the geometrical arrangement of primary particles will ever be perfectly known." Thus Wollaston's conception of the combination of four particles with another is exactly the same as our modern idea of the arrangement of four monovalent atoms (or groups) in combination with a carbon atom. The same idea is also developed somewhat later by Ampère in his "Letter to Berthollet" (*Annales de Chimie*, 90, p. 43–86, 1814), in which he considers the molecules as forming various geometrical figures dependent on the number of atoms contained therein.

JOHN CANNELL CAIN.

The Owens College, Manchester, December 14.

THE MANŒUVRING POWERS OF STEAMSHIPS AND THEIR PRACTICAL APPLICATIONS.

IN a recent number of the *United Service Magazine*, I wrote an article tracing briefly the history of manœuvring powers of steamships as ascertained and applied, or as assumed and applied, or as omitted in application, to the purposes of war and navigation. It was chiefly addressed to the Navy as my apology for certain published views on the causes of the loss of the *Victoria*, but it is suggested that a *résumé* with diagrams would interest the readers of NATURE.

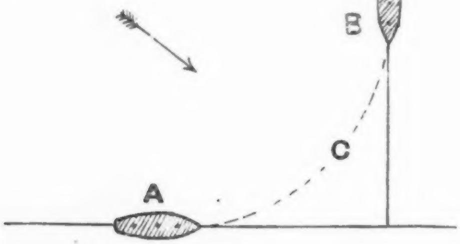


FIG. 1.

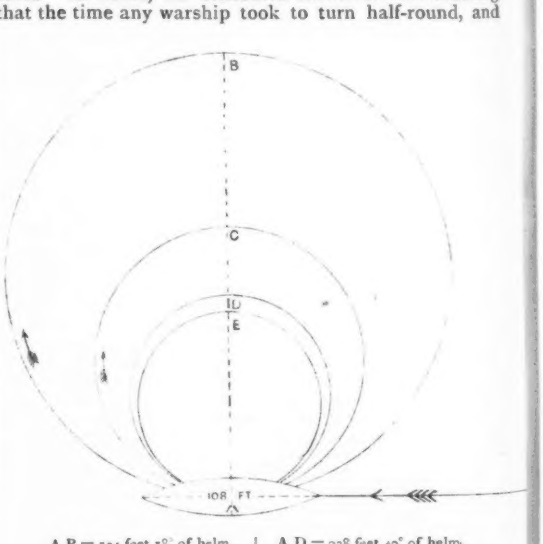
Quite in the early days of steamers it was noticed that when they turned under the influence of their helms, they took a wider and more regular sweep than seamen were accustomed to notice in sailing-ships. There was a limit to their powers; for when a steamer had put her helm "hard over," she had done all she could to turn "sharp," and if the turn was not sharp enough to avoid collision, for instance, it inevitably took place unless she could check her impetus in time by reversing her engines.

When steamers began to multiply—I speak of a date before 1854—collisions with them began to multiply also, and it was necessary to devise "rules of the road" for their prevention, such as sailing vessels had for generations possessed amongst themselves. Admiral Beechey, to whom the matter was confided, could not escape from his knowledge of the sweep that steamers made in turning, but it did not occur to him to make any investigations into its nature. He assumed it. Having done so, it did not occur to him that the application of his assumption could only be made by diagram to scale. He therefore based a proposed law on the assumption that the first 90° of a ship's path was a circular arc, but he did not specify what its radius might be in terms of the ship's length. I reproduce in Fig. 1 the fundamental diagram of the great "law of port helm" which was set out in Clause 296 of the Merchant Shipping Act, 1854, and was finally condemned by Parliament in August, 1860. The fact was that no steamer ever did, or could, turn on the path represented, and that the law could not have been drawn had the Admiral been aware of the real path, and had he applied it by means of diagrams drawn to scale.

When the single screw began to supersede the paddle, the characteristics of the turn remained, but constructive difficulties increased the sweep in warships. The late Admiral Sir Cooper Key, being in charge of the Steam Reserve at Devonport, carried out investigations—very incomplete in those days—which culminated, in 1863, in a series of experiments with a gunboat, directed to ascertain the relations between helm-angle, area of rudder, and the length and duration in time, of the path described in turning completely round. It was still assumed that the path was circular from first to last, and the results as to helm-angle are shown in Fig. 2. The "diameter" of an assumed "turning circle" was the comparative space-measurement employed. The result of the experiments was the introduction of the "balanced rudder" into the Navy.

Our first ironclad, the *Warrior*, had been more than a year at sea when these experiments were made. She was 380 feet long, much longer than any other man-of-war, except her sister, the *Black Prince*, and the time she took to turn round, as well as the space she evidently covered, were tremendous. Still assuming that every part of her path in turning was circular, means were devised to measure its "diameter," which was found to be six times her length, or 760 yards; while, at 12 knots, it took her 7m. 46s. to turn completely round. Everyone was much impressed, but the smallness of the helm-angle—22°, due to want of power to move the rudder over—was much less noticed than the length of the ship; and the fact bore remarkable fruit.

Great changes of thought on the subject of manœuvring occurred both at home and abroad. Everywhere the idea of the circular arc was accepted; no means had been invented for discovering the form of the path, and it was not sufficiently plain that only the first 180° of the turn was of any importance, and that knowledge of the nature of the path for the first 90° was the most important of all. Abroad, the idea of the circular arc was made the substructure of vast and embracing theories. Admiral Boutakov, of the Russian Navy, based a complete system of tactics on the diagram reproduced in Fig. 3, which he called "tangential arcs." It may be seen that the path from S to S′ does really embrace the whole question of helm-manœuvres. But no ship beginning to turn at N, and turning back again, could ever, by any possibility, reach W, or S′. The assumptions were entirely apart from the facts. At home, we contented ourselves with ordering that the time any warship took to turn half-round, and



A B = 534 feet 18° of helm. | A D = 238 feet 40° of helm.
A C = 318 feet 30° of helm. | A E = 216 feet 45° of helm.

NOTE.—The ship is drawn on twice the scale of the rest of the diagram.

FIG. 2.—Scale, $\frac{1}{2}$ inch = 100 feet.

completely round, at named speeds, should be recorded, and that the "diameter" of her "turning circle," measured in any way that seemed suitable, should at the same time be ascertained. No advance in the matter could be arrived at by any single experiment of this kind, but I found in later years that a great fund of knowledge

lay buried, which could be dug up when numbers of the experiments were compared.

Meantime the condemnation of Admiral Beechey's law by Parliament had put those concerned on devising a substitute. Discussions over the subject went on from August, 1860, to January, 1862, but there is nowhere any sign that the manœuvring powers of the ships to be dealt with ever came into view at all. A single diagram survives, which is reproduced in Fig. 4. It is obviously not to scale, but was intended to show that a movement proposed to be prescribed for one of the ships would be a

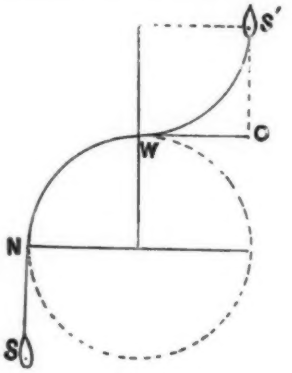


FIG. 3.

dangerous one. It was not noticed that if scale were applied to the diagram, it would show that no possible movement on the part of either ship could avoid the inevitable collision.

The Rules of the Road of 1862 have been continually modified since; and by some appeal to experiment as applied to diagram, the British delegates at the Washington Conference in 1889 were able to carry material amendments. But the fallacy of the original basis has been perhaps most forcibly brought out by Mr. John

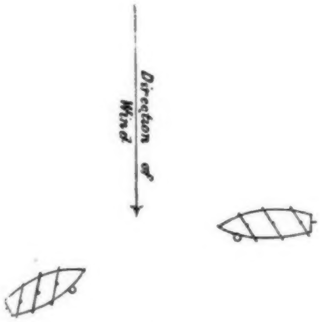


FIG. 4.

Glover before the Statistical Society in 1892. He showed that while in the decade 1880–90, all other wrecks about the coast of England have been reduced from 705 to 353 annually, the wrecks by collision have increased from 69 to 72 annually.

The Rules of the Road—not yet superseded by those of the Washington Conference—were once very carefully attacked by means of experiment and diagram to scale. The answer, made by the highest authority at the time, was based on the diagram reproduced in Fig. 5. The point was, what action No. 1, when steering at different angles across No. 2's path, ought to take to avoid her. The diagram is again clearly not to scale; but if scale be applied, it is seen that No. 1 is always so placed that no steps taken by her could possibly avoid collision.

In 1865 I had the honour to be entrusted by the Admiralty with the task of designing a system of manœuvring iron-clad steam fleets to supersede that under which Nelson had fought his battles, and which still remained intact. I was enabled, by the kindness of the Admiral commanding the Channel Fleet, to carry out a series of experiments, incomplete no doubt, but sufficient for my immediate purpose. The reduction of these experiments to scale diagrams became the basis of a system of manœuvring which has scarcely been modified, though it has been added to, down to the present day. The flaw in it undoubtedly was the enforced assumption of the circular arc, by the want of better methods of measurement, and the fact that Boutakov's diagram represented general belief.

The failure to duly connect helm-angle with the turning powers of the *Warrior* now began to bear its fruit

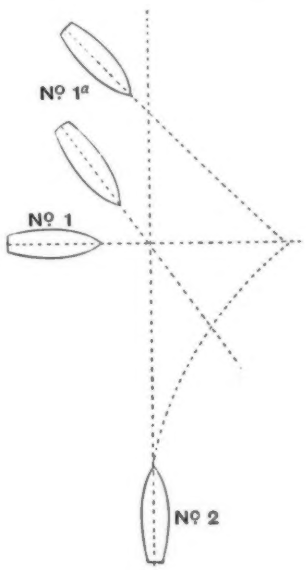


FIG. 5.

in a new direction. The present Sir Edward Reed, K.C.B., became Chief Constructor of the Navy in 1863. He was greatly impressed, as everyone then was, with the necessity of good manœuvring powers in men-of-war. He connected bad manœuvring powers, as everyone else then did, with length, and he was not impressed more than anyone else was, with the desirability of systematic experiment to ascertain what manœuvring powers really were, and what share different elements had in influencing them. He proceeded, with universal commendation, to reconstruct the Navy on the thesis that a short ship was necessarily a better manœuvrer than a long ship. His *Bellerophon*, only 300 feet long, was laid down in 1864, and his *Hercules*—still regarded by the whole Navy with affection—only 325 feet long, was laid down in 1866. Sir Edward was justly proud of the manœuvring powers of the *Bellerophon*, whose "diameter" was only 401 yards, as compared with the *Warrior's* 760. It was not sufficiently noted that the smaller space was due in greater proportion to the increase of helm-angle, by means of Captain Key's

balanced rudder, from 22° in the *Warrior* to 37° in the *Bellerophon*, than from the decrease in length from 380 to 300 feet. But it was really for want of experiment and diagram reduced to scale, that the error was committed of exaggerating the element of length. As a fact

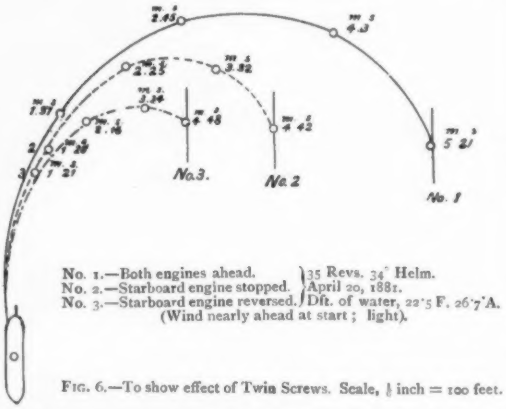


FIG. 6.—To show effect of Twin Screws. Scale, $\frac{1}{8}$ inch = 100 feet.

it is but one element out of many. The *Edinburgh*, for instance, which is 325 feet long, requires a "diameter" 93 yards longer than the *Minotaur*, which is 400 feet long.

beginning to be applied to the rudders, so that any helm-angle provided for, could be obtained at any speed. These changes in the elements of manœuvring powers demanded especial study; and, most of all, some more complete and accurate method of measurement. Anticipating, I here show, in Fig. 6, what these developments came to in the case of H.M.S. *Thunderer*, and how little modification the twin-screw can make in the early part of the turn.

The invention of a satisfactory method of measurement is due to Mr. Philip Watts, late of the Admiralty, who, in the year 1877, applied it to the *Thunderer* for purposes that had nothing to do with manœuvring. But the experiments showed how very far from circular the path really was, and how misleading the idea of a circular path had been. Collisions, unaccountable before, were now easily accounted for, and a terrible opportunity of bringing the new light to bear was offered when, in 1878, the *Bywell Castle* ran into and sank the *Princess Alice*, destroying 600 lives. The accident was wholly a question of manœuvring. Starting, as it was possible to start, with the assumption that the *Princess Alice* was legally wrong in turning to the left when approaching the *Bywell Castle*, disclosing her movement by exhibiting first her red and then her green light in front of the latter ship, the question remained as to what was safe for the *Bywell Castle* to do? She did turn to the right and sink her neighbour. Ought seamen to be instructed that the movement was a right or a wrong one as an answer to the signal received? The diagram which is reproduced in Fig. 7, was carefully prepared by putting all the facts into line with the best experiments, but it was found im-

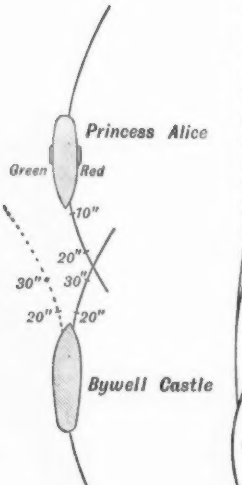


FIG. 7.—Scale, $\frac{1}{8}$ inch = 100 feet.

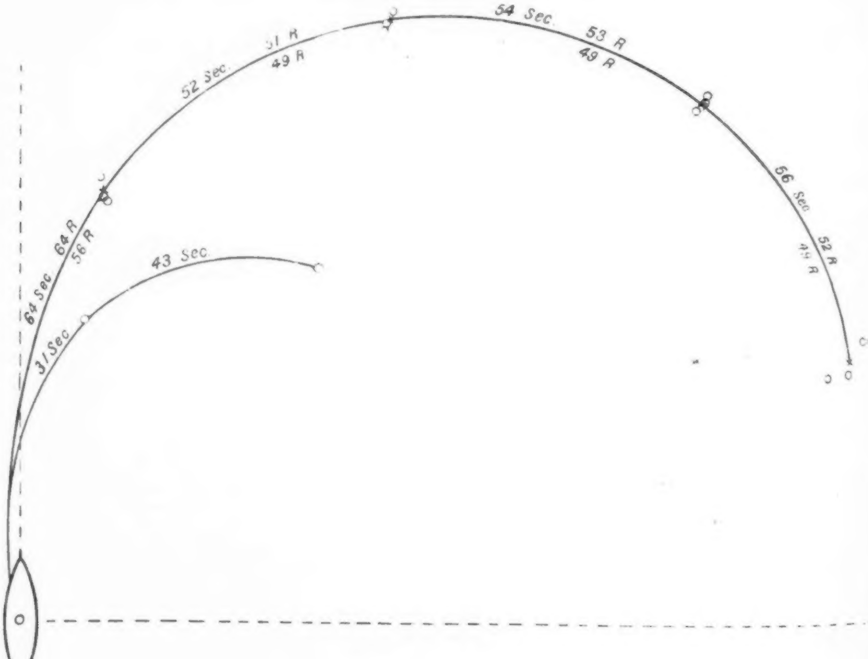


FIG. 8.—Scale, $\frac{1}{8}$ inch = 100 feet.

The twin-screw began to make its appearance in the early days of Sir E. Reed's control of our shipbuilding, and he pushed it forward vigorously. Several twin-screw battleships were launched, and others laid down before he left office in 1870. At the same time steam power was

possible to bring ideas of the manœuvring powers of the ships, and the causes of the accident, together into the discussion. The form of the accident was common, and it remains common; but no teaching yet exists which might help seamen to avoid it.

It was somewhat remarkable that in this same year in the Navy, just, it might be said, when the means of fully applying the experimental method to fleet manœuvring became available, the tide set strongly against experiment. The recommendations for experiment were curtailed, and special promptings and means for carrying out experiments, which had been usefully employed for four years, were withdrawn. The feeling grew that what had been done in 1865 was sufficient for all time; and those who were responsible for errors and shortcomings in 1865, because of the defective means for experiment, found themselves met by the stubborn character of their own mistakes when they desired to amend them. The Navy became too satisfied with the work of 1865, and felt in everything else disposed to trust to the chances and judgment of the moment when manœuvring the ships in a fleet. What was lost by failure to pursue the experimental method was not seen, and when I state clearly that if the experimental method could have been persevered in and developed, we should not have lost the *Victoria* and Sir George Tryon, my views are scarcely apprehended by the Navy. I cannot enter upon this matter here, though I shall presently make a remark on it which will then be understood. I must conclude my paper by setting forth some of the results which have been obtained by the experimental method.

In the first place it seems made out that every improvement in the method of measuring manœuvring powers has shown less apparent variation in the movement of ships under given conditions; and when, with any given method, the observers grow skilled, the apparent variations of movement become less. The accuracy of movement of all ships at speed when turning is remarkable. The curve traced in Fig. 8 is the mean of three turns of 180° to the right, made by the *Edinburgh*, at an original speed of twelve knots, and with a helm-angle of 34°, reached, by means of steam steering gear, in 11 seconds. The small circles represent the successive positions fixed by observation when the turn had reached 45°, 90°, 135°, and 180°. The figures on each side of the trace represent the total revolutions of each screw, and the seconds marked denote the time occupied in passing over each "octant." The accuracy of the turn is apparent to the eye, and while the space measurements in no case vary more than 60 feet from the mean, the time measurements do not vary more than five seconds from the mean, and that is out of a total of 220 seconds.

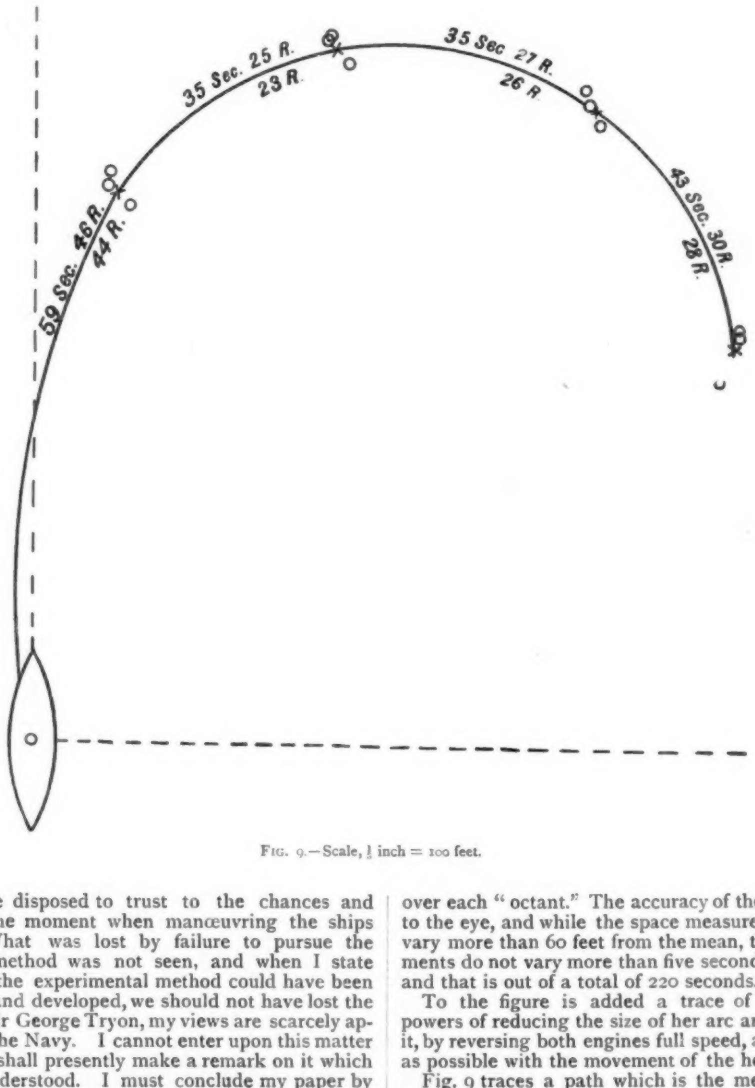


FIG. 9.—Scale, $\frac{1}{8}$ inch = 100 feet.

To the figure is added a trace of the *Edinburgh's* powers of reducing the size of her arc and her speed over it, by reversing both engines full speed, as simultaneously as possible with the movement of the helm.

Fig. 9 traces a path which is the mean of three turns made by H.M.S. *Dreadnought* at 10·9 knots speed with 32° of helm, where the apparent variations in the path seem to be greater. But the space variations here are never more than 74 feet from the mean, while the times

do not vary more than eight seconds from the mean out of a total of 176 seconds. This remarkable precision has been always found. It was equally present in a steam pinnace, and the one experiment made with a very light ship in a high wind failed to disclose any difference due to differing directions of the wind.[1]

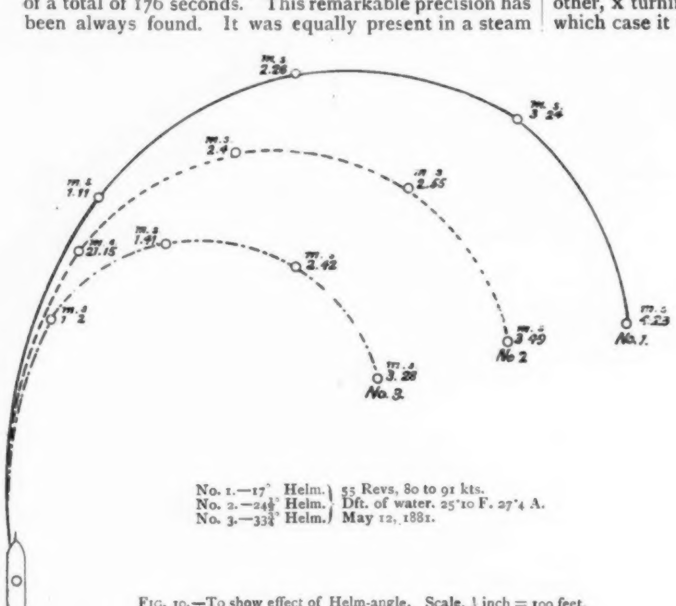


FIG. 10.—To show effect of Helm-angle. Scale, ⅛ inch = 100 feet.

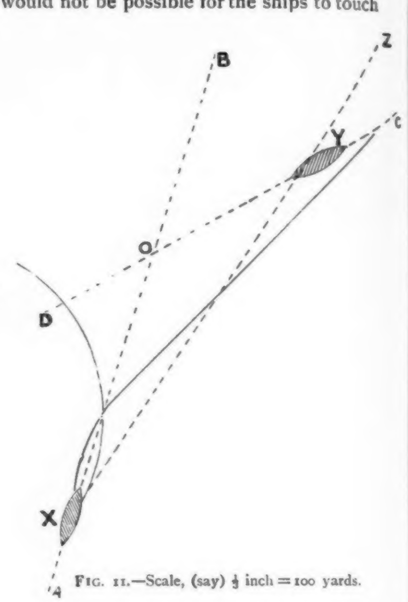


FIG. 11.—Scale, (say) ⅓ inch = 100 yards.

The traces of the *Edinburgh* and *Dreadnought* are brought together in order to exhibit the wide differences that exist in the form of the path described by different ships in turning. They show how imperative it is that in fleets, at any rate, these differences of form should be recognised.

But the peculiarity of the form of the path remains nearly the same at all helm-angles, and this makes the necessary equalising of the paths for the purposes of fleet manœuvring easier. It shows, too, the fallacy of the 1865 idea—still preserved—that there can be a single "evolutionary helm-angle" suitable to equalise a large or a small turn. The facts are illustrated by Fig. 10, which shows the effect of varied helm on H.M.S. *Thunderer*.

I have now only to point out how experiment bears on the question of collision between ordinary ships at sea. The ordinary form of approach before collision is given in Fig. 11. The law enjoins that Y should keep steadily to her path, and that X should "keep out of her way." In order to do so, she has been for something like thirty years told that she must decide for herself whether to turn to the left or to the right. Needless to say that as she cannot hope to turn "sharper" than the path marked for her, she generally produces collision by turning to the left, but she is never explicitly condemned for that act.

Ships often only discover one another when so close that it cannot be certain which has the power of avoiding collision. Fig. 12 supposes two *Edinburghs* meeting under such conditions, where it is seen that safety can alone lie in knowledge of the general manœuvring powers of ships and their application to the particular case. Admiral Beechey's law would have caused both these ships turn to the right, and would have made collision inevitable. The existing law—if it were acted on—would compel Y to keep her course, in which case also collision would be inevitable. The natural law, based on experiment, would make each ship turn towards the other, X turning to the right, and Y turning to the left; in which case it would not be possible for the ships to touch

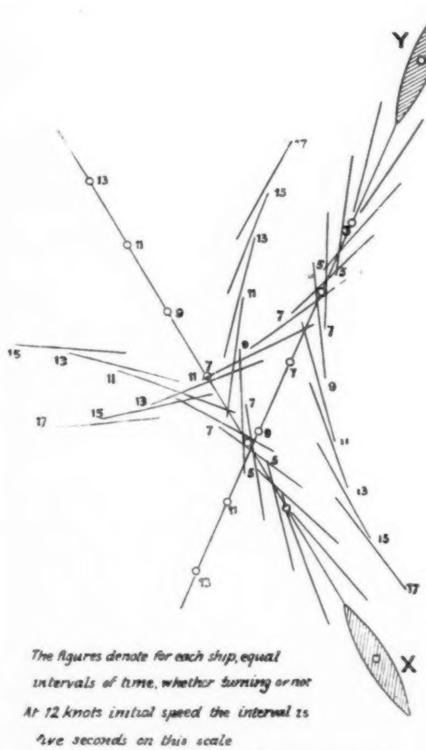


FIG. 12.—Scale, ·288 inches = 100 yards.

[1] I have by me many scores of experiments made with fifteen or sixteen ships and vessels of all sizes and classes.

at all. The rule would evidently apply safely in every such case, unless the ships had nearly equal manœuvring powers, and were then so placed that their turning arcs coincided; two concomitant conditions almost impossible to exist. Needless to say that the results of actual collisions exactly follow the diagram.

It now remains to express my general belief as to the *Victoria*. The paths in turning given of the *Edinburgh* and *Dreadnought* are those of two of the ships which were present on the occasion of her loss. Whether or not they had these traces on board I do not know. There is no mention of such things in the Minutes of the Court Martial, and the questions and answers never go beyond the work of 1865–74. But it is to me inconceivable that the mistake could have been made had such traces been familiar in every ship, and had the late Sir George Tryon been supplied with those of all his ships as a matter of course.

I think that, while blame for this accident has been authoritatively and unauthoritatively strongly thrown on individuals, it is impossible for anyone realising what I have written, to blame any one individual.

P. H. COLOMB.

THE TUNICATE.

FAR down in the depths of the ocean
  The Tunicate's active and gay;
It hasn't the ghost of a notion
  How cellular tissues decay.

With a notochord all down its central part,
  It is surely a wee morsel vain;
For it knows it possesses a ventral heart,
  Not to speak of a dorsal brain.

Then down in the depths of the ocean
  The Tunicate's lightsome and free;
It hasn't the ghost of a notion
  How degenerate old age can be.

For it must be a pleasing sensation
  That, if other resources all fail,
You can never come quite to starvation
  If you've been endowed with a tail.

Then down in the depths of the ocean
  The Tunicate's careless and glad;
It hasn't the ghost of a notion
  Its instincts all tend to the bad.

Till, wearied by youthful diversion,
  It thinks it will rest on a stone.
It becomes disinclined for exertion.
  —Ah! Tunicate, you are undone!

Now, down in the depths of the ocean
  That Tunicate's losing his tail:
As though he had swallowed a potion,
  His mental resources all fail.

His brain and his nerves they degenerate,
  His notochord meets a like fate;
You hardly can class him, at any rate
  He's no longer a true vertebrate.

And down in the depths of the ocean
  He gets him a cellulose frock;
And all just because of that notion
  Of taking a rest on a rock.

And there is a moral deduction,
  Which I'd like you to cogitate often:
Don't we all know of stones where, by suction,
  We stick, till our intellects soften?

R. M.

NOTES.

THE Croonian lecture of the Royal Society for 1894 is to be delivered by S. Ramón y Cajal, Professor of Histology and Pathological Anatomy in the University of Madrid. The subject will be "The Minute Structure of the Nervous System," and the date, March 1.

ON February 16 next, Prof. E. Haeckel celebrates his sixtieth birthday, and in honour of the event it is proposed to place his marble bust in the Zoological Institute of Jena. Friends and admirers of Haeckel who desire to support this object, should send their subscriptions to Prof. Richard Semon, Jena.

MISS KLUMPKE, the well-known lady assistant at the Paris Observatory, took the degree of Doctor of Mathematical Science at the Sorbonne, on December 14. The subject of her thesis was Saturn's rings.

PROFS. BARNARD AND ASAPH HALL have been awarded the Arago Prize for Astronomy by the Paris Academy of Sciences.

PROF. C. F. MABERY has received a grant of 300 dollars from the American Academy of Arts and Sciences, to enable him to carry on his investigations of the American sulphur petroleums.

THE death is announced of Dr. J. Boehm, Professor of Botany in Vienna University, of Dr. D. A. Brauns, Extraordinary Professor of Geology in Halle University, and of Dr. P. A. Spiro, Professor of Physiology in the University of Odessa.

IT appears from the will of the late Sir Andrew Clarke that he has bequeathed the sum of £500 to the London Hospital Medical College, for the foundation of a scholarship.

AT a special general meeting of the Royal Institution of Great Britain, held on Friday last, the following resolution was unanimously adopted:—"That the members of the Royal Institution of Great Britain, in special general meeting assembled, hereby record their deep regret at the death of Dr. John Tyndall, D.C.L., LL.D., F.R.S., who was for forty years connected with the institution as lecturer, professor, and honorary professor of natural philosophy, and who by his brilliant abilities and laborious researches nobly promoted the objects of the institution and conspicuously enhanced its reputation, while at the same time he extended scientific truth, and rendered many new additions to natural knowledge practically available for the service of mankind; and that the members of the Royal Institution further desire to convey to Mrs. Tyndall an expression of their sincere sympathy and condolence with her in the bereavement she has sustained in the loss of her gifted and distinguished husband."

WE learn from the *Victorian Naturalist* that Baron von Mueller has withdrawn from the directorship of the International Academy for Botanic Geography of Le Mans.

AFTER remaining dormant throughout historic time the volcano El Calbuco in the Andes (Lat. 41° 21′ S. Long. 72° 38′ W.) has renewed its activity. Mr. A. E. Nogues described the eruption in a communication to the Paris Academy, on December 11. Some months ago, columns of vapour began to issue from the crater, their escape being accompanied by the usual subterranean noises, seismic movements, and electrical phenomena. This stage was followed by the ejection of scoriæ and rock fragments in such large quantities that the surrounding woods were burnt up, and the ground raised to a comparatively high temperature. At the present time the volcano is in full play. Lava has issued from the sides of the cone and flowed down to the base, forming streams of molten rock which have barred the way of torrents and changed the directions of rivers. This phase of the eruption, however, marks a decline of activity, and will in all probability be followed by the quiet emission of gaseous products.

By the generosity of M. G. Solvay, two important institutes have been established at Brussels, namely, a University Institute of Physiology, and an institute specially designed for carrying on electro-biological researches. In May last M. Solvay presented the town with a sum of two hundred thousand francs for the erection and equipment of the University building, stipulating only that the University should provide courses in physiological chemistry, and medical physics relating to the connection between physiology and electricity. This condition was laid down with the object of improving the instruction at the University, and developing the spirit of investigation in the minds of students, thus giving them the ability to carry on physiological researches independently in a special laboratory. For students thus trained, and desiring to apply their knowledge to research of a special kind, the Solvay Institute has been established. At the inauguration of this institute, on December 14, M. Solvay delivered an address on the rôle of electricity in the phenomena of life. He remarked that his conviction was that the phenomena of life could probably be explained by the action of physical forces, and that, among these forces, electricity played an important part. It was to obtain evidence on this point, by the observation and study of facts, that M. Solvay was led to found the institute that bears his name.

An appeal has been made for funds to establish a small station at Millport for the study of the marine zoology and botany of the Firth of Clyde and West of Scotland generally. It is intended to establish in connection with the station a representative collection of local marine fauna and flora, and, should the funds permit, to construct tanks for the study of living animals and plants. A station, on a limited scale—centred in a small vessel called the *Ark*—has existed at Millport for some years, and has been found exceedingly useful. During 1891 and 1892, the Royal Society of London gave a grant of £100 for the investigation of the algæ of the Clyde sea area. This work was carried on chiefly in the *Ark;* the result being that about eighty species new to the district were found, and of these between twenty and thirty were new to Britain, and about six new to science. The advantages which a permanent station would offer to students of natural history are sufficiently obvious. As the scheme has the cordial approval of many of the Professors at Glasgow University, and also the support of local naturalists, there should be little difficulty in obtaining the contributions required to realise it.

We learn from the Allahabad *Pioneer* that subscription lists will be opened immediately for the Pasteur Institute scheme. The Amritsar municipality have sanctioned a donation of 1000 rupees and an annual subscription of 500 rupees. The Gurdaspur municipality had previously promised a donation and an annual grant, and among other donations promised are 1000 rupees from Khan Bahadur Barjorjee D. Patel of Quetta. The Government of India have promised to give the services of a qualified medical officer to superintend the institution, which is equivalent to an annual donation of at least 12,000 rupees. Altogether the committee will commence their work under most favourable auspices.

Mr. E. A. Minchin, whose election to a Fellowship at Merton College, Oxford, we noted last week, was placed in the first class in the Honour School of Natural Science (Animal Morphology) in 1890, and has since been a Demonstrator in the Linacre Department of Comparative Anatomy. It is understood that the examiners sent in a special report to Merton College, to the effect that all of the eleven candidates for the Fellowship acquitted themselves with distinction, and were, in the opinion of the examiners, fully up to the standard required.

The following appointments have recently been made in America:—Mr. W. S. Aldrich, Professor of Mechanical Engineering, West Virginia University; Mr. F. F. Almy, Professor of Physics, Iowa College; Dr. Charles E. Coates, Professor of Chemistry, Louisiana State University; Dr. A. J. Hopkins, Professor of Chemistry, Westminster College, Pa.; Dr. H. B. Loomis, Assistant Professor of Physics, Northwestern University; Dr. M. M. Metcalf, Professor of Biology, Woman's College of Baltimore; Mr. A. M. Muckenfuss, Professor of Chemistry, Millsaps College, Miss.; Mr. S. L. Powell, Professor of Natural Sciences, Newberry College, S.C.; Dr. H. L. Russell, Assistant Professor of Bacteriology, University of Wisconsin; Dr. J. N. Swan, Professor of Chemistry, Monmouth College, Illinois.

In a recent *Bulletin* the State Board of Health of Michigan makes the assertion that the statistics of sickness indicate a connection between atmospheric ozone and influenza. Speaking generally, influenza increases with the proportion of ozone in the atmosphere. On the other hand, remittent fever decreases as the proportion of ozone increases.

The following science lectures will be given at the Royal Victoria Hall during January:—Prof. Smithells on "Flame"; Mr. R. W. Frazer on "Life in South India"; Mr. F. W. Rudler on "Diamonds"; and Dr. Waghorn on "Our Eyes, their merits and failings."

Writing upon "South American Meteorology," in the *American Meteorological Journal* for December, Prof. W. H. Pickering remarks that the Harvard College Observatory has four meteorological stations in Peru, all within one hundred miles of one another. The first is at Mollendo, on the sea coast, with an altitude of 100 feet: the second is at La Joya, in the desert—altitude 4140 feet; the third is the observatory in the Arequipa oasis—altitude 8060 feet; and the fourth is at the Ravine Camp upon Mount Chachani—altitude 16,600 feet. A fifth has recently been established, by Prof. S. I. Bailey, upon the summit of the Misti, at an altitude of 19,200 feet. The observations made at these observatories will doubtless lead to a much more accurate knowledge of the meteorology of Southern Peru than we at present possess.

At the meeting of the Royal Society of New South Wales, on November 1, Mr. H. C. Russell described a new form of rainfall map. Instead of having different tints to indicate different amounts of precipitation, Mr. Russell divides the area over which the observations extend into square degrees, and by means of large figures printed on each square, shows to the nearest quarter of an inch the mean rainfall for that spot. Other smaller figures are used to show the number of years the observations have been made, and the number of stations used to find the mean. The map thus gives a large amount of information about the average rainfall of a country, and, at the same time, it shows in a conspicuous manner lines of equal rainfall and outlines of large areas of heavier rainfall, like the shaded maps; giving, in addition, what the shaded map cannot exhibit, viz. the variations in the rainfall of these areas of heavier rain. A map of New South Wales was prepared on this principle by Mr. Russell, specially to meet the wants of the agriculturist; but after it had been completed, it was found to serve the requirements of the meteorologist better than any map constructed on the shaded plan.

In *Hansa* of the 9th instant, Captain C. H. Seemann discusses the meteorological conditions which accompanied or preceded the slight outbreak of cholera at Hamburg this year, and the serious epidemic of 1892. A comparison of the curves of the temperature of the air and the water of the Elbe for the corresponding period of each year shows scarcely any difference,

while the level of the river was lower near Hamburg this year. It appears from the facts brought forward, that meteorolgical conditions were in no way connected with the outbreak or spread of the disease, and that the cause must be attributed entirely to the accidental contamination of the water of the Elbe.

AN abstract on the "Occurrence of Amber in Russia," by Fr. Th. Köppen, is published in *Petermann's Mitteilungen*, November 1893, pp. 249-253. The original paper by the same author appeared in a Russian publication. Amber is found on the Baltic shores, the south coast of the Gulf of Riga, and in turf-moors or ancient gulfs of Kurland, embedded below thin beds of turf or sea-sand. Farther north, it occurs on the shores of the Oesel Island, and even in South Finland. The Polish localities along the river Narew are supposed to have been those referred to by Pliny. The most extensive occurrence is in the western provinces of Russia, and in different places on the banks of the Dneiper. From these facts, the "amber-formation" may be said to occur in Western Russia, from the Baltic to the Black Sea. A recent paper, written by N. Sokolow, shows that the lower tertiary deposits of Southern Russia extend also throughout this area. Sporadic appearances of amber occur in the southern parts of Bessarabia in brown-coal strata; they are possibly associated with the amber found in Roumania. Other Russian localities are the Arctic shores of Russia and Siberia, and on the Sea of Okhotsk. A sketch-map accompanies the text, showing the distribution of lower tertiary deposits according to Sokolow, and the most important occurrences of amber in Russia.

LAST week's number of *Die Natur* concludes a series of eleven articles written by A. and S. Ortleb. The title of the series is "Introduction to specimen-collecting, geological and palæontological." The early chapters run rapidly through the physical and geological history of the development of our earth, and point out the significance of the fossils found in sedimentary beds. A short, systematic description follows of the chief groups in the plant and animal kingdoms. A few of the more interesting genera are mentioned, illustrations are given along with the text, and care is taken to bring out the particular epochs and localities to which the fossil representatives belong. This admirable contribution to popular scientific literature will supply a want widely felt among amateur collectors in Germany.

MR. M. CAREY LEA, who recently described a method of transforming mechanical work into chemical action in the *American Journal of Science*, has been continuing these interesting researches, and gives a description of some further remarkable results in the current number of the same journal. Instead of an enormous simple pressure, he tried shearing stress, and obtained more striking and apparent reactions than by the former method. In one series of experiments he placed a small quantity, a few decigrams, of a metallic salt in a mortar, spread it into a thin uniform sheet over the bottom, and rotated the pestle with the utmost force that could be exerted. Two of three decigrams of chloroaurate of sodium left 1·8 milligram or metallic gold. Under the action of the pestle the yellow colour of the salt gradually deepened to an olive shade. When water was poured on, the undecomposed salt dissolved, leaving the gold as a delicate purple powder. Half an hour's trituration of half a gram of the salt resulted in the reduction of 9·2 mgrms. of gold. This reduction represented the conversion of about 500 gram-meters work into chemical energy. Since the reaction is endothermic, there is no doubt that the energy was derived from the mechanical power. That the reaction was not produced by heat was proved by carrying on the operation intermittently, when the reaction took place in the same way, and also by the partial reduction of corrosive sublimate to calomel by a similar operation. By heat, corrosive sublimate sublimes unaltered. The same conclusion can be drawn from other reactions. Salts of mercury, platinum, and silver gave results analogous to those in the case of gold. In another series of experiments Mr. Carey Lea imbued pure strong paper with a solution of the substance, dried it thoroughly, and laid it upon a piece of plate glass. Characters were then marked on it with the rounded end of a glass rod, using as much pressure as possible without tearing the paper. Marks were thus immediately obtained in the case of potassium ferricyanide, gold and platinum chlorides, mercuric oxide, and many silver salts. The author accounts for the more immediate action of shearing stress in effecting chemical changes by the increased vibration and consequent shattering of the molecules, the action being analogous to that brought about when a bow is drawn over a stretched cord.

THE third number of the *Physical Review* contains a paper, by Alexander Macfarlane and G. W. Pierce, on the electric strength of solid, liquid, and gaseous dielectrics. In the course of a previous research Dr. Macfarlane had found that the "electrical gradient" necessary to force a spark through a thin stratum of dielectric diminishes as the thickness increases, when air or other gas is the dielectric, but remains constant when turpentine or other insulating liquid is the dielectric. Mr. Steinmetz has shown that solid dielectrics, such as paraffined paper, behave in the same way as the liquid dielectrics. In order to obtain more trustworthy observations on these points, the authors have compared the electrical gradient necessary to break down different solid and liquid dielectrics with that required in the case of air. For this purpose they employed two discharging tables, each table supporting two parallel discs about 4 inches in diameter, the connecting rods being joined to the poles of a Holtz electrical machine, so as to form two alternative paths for the discharge. One of the tables, that used for the air gap, was provided with a micrometer by which the distance between the plates could be measured. The sheets of dielectric were placed between the other pair of discs, and the air gap enlarged till a spark passed through the solid dielectric. The difference of potential required was calculated from the length of the air gap, using the results published by Macfarlane and Steinmetz. The equivalent thickness of air is not proportional to the thickness of the solid or liquid, but increases more rapidly as the stratum increases in thickness; the difference of potential, however, required to break down a solid or liquid dielectric is proportional to the thickness. Thus it appears that while thin strata of solid or liquid dielectrics are equally strong whatever the thickness, thin strata of gaseous dielectrics grow weaker as the thickness increases. The authors consider that this difference is not due to a surface phenomenon, but to the greater rarity of the gas which allows discharge by convection to be more readily set up. They find that for liquids, when the thickness is considerable, convection currents are sometimes started, and that in this case the discharge takes place at a lower difference of potential.

Wiedemann's Annalen for December contains a description of a modified form of Thomson quadrant electrometer, which has been employed by Herr F. Himstedt. The chief characteristics are the employment of the form of needle which Lord Kelvin uses in his multicellular voltmeter, suspended by a quartz fibre. The lower end of the row of needles carries an insulating stem, to which are fixed two small magnets. These magnets are placed with their axes vertical, so that the earth's magnetism has no tendency to cause rotation of the needles, and are surrounded by a thick copper shield, the induced currents in which damp the oscillations of the needle. The fibre by which the needle is suspended is covered with a thin coat of deposited silver, so that it conducts, and thus allows the needle to be

charged. With a period of 22 seconds, and when the needle is charged by means of 80 small accumulators, one Clark cell gives a deflection of 800 scale divisions on a scale 250 c.m. from the instrument.

JUST now Saxony, of which Chemnitz is the most important manufacturing centre, is interested in the comparisons being made in Switzerland between steam-power plants and electricity gained by utilising water. In connection with this subject the United States Consul at Chemnitz has recently made the following remarks (*Board of Trade Journal*):—"It used to be urged that Switzerland's water supply, if properly utilised for obtaining electricity, would reduce very considerably her cost of production. Not only has she many streams, but they fall from such heights that even rivers of small volume have great power. . . . Every effort that science could suggest, ingenuity devise, or mechanics arrange, was made in different cantons of the little Republic to gather electricity by, and transmit it from, her rivers and streams. The latest reports show that if Switzerland, or any country with streams and climate like hers, is to win her way into the world's markets and take a place in the front ranks, it must be by some better method than the use of electricity gained and transmitted from rivers and waterfalls." Electricians will doubtless have something to say on this matter.

ONE of the factors in the so-called self-purification of river-water is regarded by some authorities to consist in the destruction and oxidation by bacteria of some at least of the organic material present. Prof. Pettenkofer, who has been investigating the condition of the river Isar, in the vicinity of Munich, is of opinion that the green living algæ found in this water also play no unimportant part as purifying agents. Prof. Schenck (*Centralblatt f. Allgem. Gesundheitspflege*, 1893), who has been making a special study, from this point of view, of the Rhine in the neighbourhood of Cologne, mentions that, to his surprise, he found comparatively few algæ where most impurities were present, the former being apparently crowded out by the large masses of bacteria. On the other hand, Prof. Percy Frankland has recently stated that, contrary to what might have been anticipated, he found a comparatively small number of bacteria present in the water of a loch, which was so turbid that it was practically opaque when viewed in a glass, by reason of the immense number of algæ present. Dr. Schenck's investigations were carried out to ascertain if the city of Cologne could with safety discharge its sewage untreated direct into the river, relying upon the processes of subsequent self-purification for the water to regain its normal condition. The mass of algæ found was remarkably small, being chiefly confined to the shallows along the banks, or to those spots where protection was afforded from the rush of the stream; the varieties, moreover, present were found to vary very considerably at different seasons of the year. But according to Prof. Schenck, the condition of the river banks in the immediate vicinity of the site selected for the entry of the Cologne sewage is very suitable for the aggregation of masses of bacteria, and he maintains that in conjunction with other factors of purification, such as mass of water and rate of flow, &c., a rapid and thorough purification of the water may be expected. Whatever the general opinion may be of the wisdom of Prof. Schenck's advice, his investigations show that the alleged action of green algæ as important water purifiers cannot be accepted without reservation, but that in the case of each river or stream the nature and growth of these plants must be studied.

THE first part has been sent to us of a work entitled *Sporozoen als Krankheitserreger* (Berlin: Friedländer and Sohn, 1893), by Dr. Alexis Korotneff, Professor at the Kiew University, and Director of the Zoological Laboratory in Villafranca. This "Heft" is devoted to "Untersuchungen über den Parasitismus des Carcinoms," and is illustrated by four beautifully coloured plates showing the structure of the tissue in cancerous tumours, and the presence of parasites in various stages of development. The large amount of work which has been published during the last three years since Nils Sjöbring's paper on the parasitic nature of this disease appeared, renders a critical summary, such as Dr. Korotneff has written, of particular interest. The author admits, however, that personally the number of cancerous cases which he has examined is insignificant, but adds that the greater part of the drawings which have appeared in the works of Sudakewitsch, Sawtschenko, Kossinsky, Ruffer, and others on this subject, which are based upon observations made upon hundreds of cases, agree almost entirely with his own, and that he therefore considers his experience sufficient to justify him in expressing an opinion, not only on those cases examined by him, but also "über jede andere Krebsgeschwulst."

THE Calendar of the Imperial University of Japan for the year 1892–93 has been received.

THE latest volume of the useful Aide-Mémoire Series, edited by M. Léauté, and published by MM. Gauthier-Villars, is on the "Choix et Usage des Objectifs Photographiques." The author is Prof. E. Wallon.

WE have received a descriptive catalogue of the exhibits in the Anthropological Building of the Chicago Exposition. The anthropological laboratories contained three general subdivisions, viz. physical anthropology, neurology, and psychology. Sections were also devoted to growth and development, and to the anthropology of North American Indians.

A STATEMENT has been published of the origin, plan, and results of the field and other experiments conducted on the farm and in the laboratory by Sir J. B. Lawes, at Rothamsted, for the last fifty years. To the general statement are appended lists of the titles of all the published papers dealing with Rothamsted work, with full reference to the journals in which they appeared.

MR. S. H. C. HUTCHINSON, the Meteorological Reporter for Western India, has sent us a brief sketch of the meteorology of the Bombay Presidency from April, 1892, to March, 1893, inclusive. The year 1892 was one of barometric minimum, and consequently one of excessive rainfall throughout the whole of the Presidency. In some respects the meteorological conditions resembled those of 1878.

PATHOLOGISTS will welcome the publication of a new "Descriptive Catalogue of the Anatomical and Pathological Specimens in the Museum of the Royal College of Surgeons of Edinburgh," vol. i. In this volume the specimens which exemplify affections of the skeleton and organs of motion are described. A subsequent volume or volumes will include specimens relating to the alimentary canal, the respiratory system, &c. Mr. C. W. Cathcart, the Conservator of the Museum, deserves the thanks of all members of the medical profession for his useful and carefully compiled work.

THE *Bulletin* recently issued by the committee for the execution of the photographic star-map, contains Prof. Kapteyn's investigations on the systematic differences between the photographic and visual magnitudes in different parts of the sky. M. Loewy contributes his second memoir on the construction of the catalogue founded on the *clichés* of the star-chart, and M. Prosper Henry describes the methods of measurement and reduction of the *clichés* for the catalogue, adopted at the Paris Observatory.

'A MONOGRAPH of the North American Proctotrypidæ," by Mr. William H. Ashmead, forms *Bulletin* No. 45 of the U.S.

National Museum. In it is given a systematic description o the species of the hymenopterous family *Proctotrypidæ* found north of Mexico; the genera of the world being also studied and described, as an aid to future students. The Proctotrypidæ are considered by some authorities to be closely allied to the Chalcididæ, which they usually follow in catalogues and lists of hymenopterous families. Mr. Ashmead considers, however, that there is little affinity between the two, and that such an arrangement is unnatural. He thinks that the Proctotrypidæ should be placed at the head of the Terebrantia, for after the removal of the group Mymarinæ (which probably forms a separate and distinct family allied to the Chalcididæ), there is no relationship with the Chalcididæ.

THE first volume of "Studies from the Physical and Chemical Laboratories" of the Owens College has been published, and it furnishes evidence of the large number of important investigations carried on by the alumni of the College. The volume contains thirty papers in all, most of which have been reprinted from the Transactions and Proceedings of various societies. A paper by Mr. J. A. Harker, "On the Reaction of Hydrogen with Chlorine and Oxygen," has been translated from the *Zeitschrift für Physicalische Chemie*, and appears in English for the first time. Among the papers not previously published is one "On New Forms of Stereometers," by Mr. Haldane Gee and Dr. Harden, and another "On the Duration of Chemical Action in the Explosive Combination of Gases," by Dr. Turpin. The council of the Owens College has done a good work by collecting and publishing the results of researches made in its laboratories during the last few years.

IN his paper on the "Glacial Striæ in Somerville," Mr. Upham concludes, from a large series of observations, "that the currents of the ice-sheet were deflected here from one course to another, and even to several successive courses in so short a time that it allowed no great amount of erosion of the rock beneath." The general motion of the ice-sheet during the period of its maximum thickness was south-south-east over the Boston area, but it was deflected eastward during the recession of the ice. The long axes of the drumlins have also an eastward direction, and Mr. Upham finds in this fact evidence that they were formed wholly during the time of deflected glacial movements.

SINCE the publication, in 1868, of Pasteur's classical work, "Études sur le vinaigre," the only contributions of importance to this subject are those made in this country by Mr. Adrian Brown. It is, therefore, interesting to learn that Dr. Lafar intends devoting special attention to the whole question of the fermentation of vinegar, and the *Centralblatt für Bakteriologie*, vol. xiii. p. 684, 1893, contains his first contribution to, as well as a short review of, the existing literature on this important subject. In the course of his researches at the Institute for the Experimental Investigation of Fermentation Industries near Stuttgart, Dr. Lafar obtained a species of yeast which rendered beer strongly acid, and on studying its behaviour in other alcoholic media it was found to produce vinegar. The various observations made with this interesting organism are conveniently brought together in a table, and include the determination of the amount of vinegar produced, the changes, both in taste and smell, induced in the media, the formation of surface-film, &c. In his next communication, Dr. Lafar hopes to furnish more exact particulars of the physiological and bacteriological characters of this vinegar-producing yeast.

THE *Illustrated Archæologist* for December contains a number of very fine illustrations. Among the articles is one "On the Excavation of a Pictish Tower in Shetland," by Mr. G. Goudie. The author thinks that the remarkable round towers with the remains of which the islands of Orkney and Shetland are studded may be assigned a date as far back as the commencement of the Christian era, or earlier. Mr. Arthur Elliot writes on "Some Old Towers at Liège," and Mr. J. Romilly Allen, "On the Celtic Brooch, and how it was Worn." Dr. R. Munro contributes some notes on flint saws and sickles, in which he discusses the differences between Egyptian sickles and the saws found in the Polado lake-dwelling near Desenzano. He is of the opinion that there is little or no evidence that such sickles were in use among the prehistoric people of Western Europe, though compound saws of the kind discovered at Polado may be found among the *débris* of prehistoric civilisations beyond that of the lake dwellings of Europe.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Sir F. D. Dixon-Hartland, Bt., M.P.; a Ring-tailed Coati (*Nasua rufa*) from South America, presented by Mr. Kenelm Chandler; two Arctic Foxes (*Canis lagopus*) from the Arctic Regions, presented by the Duke of Hamilton, K.T.; a Red Kangaroo (*Macropus rufus*) from Australia, two Short-toed Eagles (*Circætus gallicus*) European, deposited; a Moloch Lizard (*Moloch horridus*) from Australia, presented by Mr. John Carter.

IN line four of article "Experiments on Flying" (NATURE, December 14), read $n^{\frac{7}{2}}$ instead of n^7.

OUR ASTRONOMICAL COLUMN.

COLOUR-ABERRATION OF REFRACTING TELESCOPES.—At a recent meeting before the Royal Astronomical Society, the proceedings of which will be found in the *Observatory* (No. 208, December), Mr. H. Dennis Taylor read an abstract of a paper entitled "The Secondary Colour-Aberration of Refracting Telescopes in Relation to Vision," which had for its aim the determination of the detriment to vision, if any, and the percentage of light lost for defining purposes, owing to the presence of the usual colour-aberrations. In the colour curves which the author exhibited, where the wave-lengths and longitudinal colour-aberrations were represented by the ordinates and abscissæ respectively, some remarkable facts were brought to light. A comparison with Captain Abney's curves of the luminous intensity of the normal solar spectrum gave a means of obtaining a rough estimate of the percentage of light thus lost. The following table gives one a rough idea of these losses for different objectives in the case of star work, 100 representing the whole amount of light transmitted:—

Objective.	Focal length. Feet.	Light lost.
36-inch Lick Telescope	57	27
24 ,, Refractor	30	42
12 ,, ,,	15	21
6 ,, ,,	7½	9
28 ,, Greenwich Refractor	28	50

Other conclusions which the author draws from the above inquiry may be stated as follows:—In large telescopes the light-gathering power for star work by no means increases as the square of the aperture, the focal length being constant, but a point is reached when it increases simply as the aperture. With a given large aperture the light-grasping power can be considerably augmented by increasing the focal length. In the case of large telescopes, a smaller telescope of relatively large focal length may actually excel in light-grasping power a telescope of larger aperture and shorter focal length. In his concluding remarks Mr. Dennis Taylor refers to the increase of size in the images of stars under increasing exposures; this, he says, can be accounted for by the photographing of the halo of wasted light which surrounds the real image. If further research corroborates the views above stated, there seems to be no doubt that there is still room for improvement in rendering our lenses more perfectly achromatic. Of course the main point in large telescopes is to have them as short as possible, and it is satisfactory to notice the comparative smallness of the light lost in the 36-inch Lick instrument.

STARS WITH REMARKABLE SPECTRA.—The present list (*Astr. Nach.* No. 3200) is a continuation of that which appeared in a previous number of the same journal (*Astr. Nach.* No. 3171).

Among some of the *more* remarkable spectra may be mentioned that of R. Coronæ, which, as Mr. Espin says, is one of the most puzzling in the heavens. The spectrum, he "feels pretty sure," is a double one, and that there is a displacement; at one time the spectra coincide and the star's light is continuous, and at another they are so displaced as to give the appearance of bright lines flanked with dark ones. T. Coronæ, which showed some years ago a nebular spectrum, seems to have undergone a change, as Mr. Espin says that it "is certainly not now the case."

A remark of interest is that the region bounded by the declinations $+51°$ and $+56°$, and R.A. 10h. 40m. and 11h. 8m. contains a large grouping of coloured stars. Out of 108 stars above 9th mag. there are seventeen which may be classed as orange-red. The region from β to ϵ Ursæ is also "very rich."

"HIMMEL UND ERDE" FOR DECEMBER.—In the current number of this journal Prof. Scheiner contributes an interesting article on the cluster in Hercules; it is accompanied both with early drawings of this fine object as viewed in the telescope, and also with the latest photograph. The last-mentioned appears, as one would suppose, as if quite another object had been photographed, so different is the result obtained. Dr. Schwahn treats in a clear manner also of a very difficult subject in an article entitled "Die Lothabweichungen und das Geoid.

A NEW VARIABLE.—In *Wolsingham Observatory Circular*, No. 38 (December 14), the Rev. T. E. Espin announces that photographs taken with the Compton telescope show that the star Espin-Birmingham 57° (R.A. 11h. 39m. 58s.; Decl. $+56°$ 23'), Magnitude 9·5, is variable. The star is now 8·5 mag. It has a Type III. spectrum.

GEOGRAPHICAL NOTES.

DR. F. A. COOK has communicated to the American Geographical Society of New York a scheme for the exploration of the Antarctic regions. He proposes to purchase a steam-whaler of 300 tons, equip her specially with several large boats, sledges, and an outfit similar to that used for Arctic travel, including fifty Eskimo dogs. The plan proposed is to steer south from the Falklands to Terre Louis Philippe, and enter the ice-barrier at the first convenient opening where winter quarters may be established and a landing effected. The adjoining land would be systematically explored and all possible scientific observations made. The scientific party will not exceed twelve or fourteen. Dr. Cook has had some experience in Arctic exploration with Lieutenant Peary, and Astrup, now with Peary on his second sojourn in North Greenland, has agreed to accompany him. It is proposed that the expedition should be one year in the Antarctic regions. Dr. Cook estimates the cost of his expedition at £10,000, which he hopes to raise by private subscriptions, grants from scientific societies, and by lecturing. While recognising the greater advantages to science likely to accrue from a national expedition on a large scale, such as that suggested by Dr. Murray, we would like well to see Dr. Cook's party also in the field, which is a wide one, and full of scientific possibilities.

REUTER'S Agency announces that Mr. and Mrs. Theodore Bent and their party left Aden on the 16th inst. for the seaport of Makalla, on the south coast of Arabia, whence they will proceed to the interior with the object of exploring Hadramant.

Ausland announces the sudden death, on November 21, in Yokohama, of the Austrian Consul-General, Gustav von Kreitner, who was with Count Szechenyi on his great journey in Central Asia as topographer. There his work was of the best quality, and made the results of the expedition permanently valuable to cartographers.

THE *Annales de Geographie*, a quarterly geographical paper edited by M.M. Vidal de la Blache and Marcel Dubois, which has just entered on the commencement of its third volume, has already taken the first place amongst French geographical journals for the comprehensive scope of its contents and the solid value of the contributions to geography which it publishes, as well as for the impartiality of its editorial notes. The last number is particlarly good, containing a coloured map of the faunal divisions of the globe, with a discussion by Prof. J. Welsch; an able treatise on the lakes of the Jura by Dr. A. Magnin, several excellent studies in local geography, an epitome of M. Maistre's great journey to the Shari, and an account of Mount Ararat by M. Chantre.

THE prospective formation of a "buffer-state" between Siam, Burma and China, necessitates a more complete survey of the region than has hitherto been attempted, and an Anglo-French Commission will probably undertake this work at an early date.

DR. H. R. MILL completed a course of twelve lectures on geography applied to commerce, at the London Institution, on Tuesday evening. The lectures were arranged by the Royal Geographical Society as a special educational course, designed to meet the wants of merchants and advanced school-teachers. The first six lectures took up the scientific basis of commercial geography, showing the relations of mathematical, physical, biological, anthropological, and political geography to the special subject. The remainder of the course dealt with the commercial geography of the larger divisions of the British Empire, in order to enforce the general principles in particular cases. The attendance throughout was satisfactory; and the same course was given on Friday evenings at Birmingham, under the Oxford University Extension scheme. Mr. Mackinder will commence the second course of educational lectures for the Royal Geographical Society on January 12, in the hall of the United Service Institution, Whitehall, the subject being the relation of geography to history.

A NEW PROCESS FOR THE PREPARATION OF ETHERS.

A NEW and advantageous general process for the preparation of ethers (alkyl oxides), including the most important from a technical point of view, ethyl ether, is described by Prof. Krafft, of Heidelberg, in the current *Berichte*. In the course of an investigation of the aromatic derivatives of sulphuric acid, it was observed that there is a complete analogy between the behaviour of sulphovinic acid and its homologues on the one hand, and the alkyl esters of aromatic sulphonic acids on the other, towards alcohols at moderately elevated temperatures. It was found, in fact, that the conclusions arrived at by Prof. Williamson in the year 1851, with regard to the processes involved in the formation of ethers from the esters of sulphuric acid, are equally applicable to the alkyl esters of the sulphonic acids. For these latter substances decompose in a precisely similar manner to the alkyl sulphuric acids upon warming with alchols, an ether being the product of the reaction. Thus, for instance, the reactions between alcohol and ethyl sulphuric acid, and between alcohol and the ethyl ester of benzene sulphonic acid, run exactly parallel, as will be apparent from the equations representing them—

$$HO.SO_2.OC_2H_5 + C_2H_5OH = HO.SO_2.OH + C_2H_5.O.C_2H_5.$$
$$C_6H_5.SO_2.OC_2H_5 + C_2H_5OH = C_6H_5.SO_2.OH + C_2H_5.O.C_2H_5$$

This new class of reactions of the sulphonic acids appears likely to prove of more than merely theoretical interest, for on account of the great stability of these aromatic substances, they are capable of converting far larger relative quantities of alcohol into ether when the reaction is made continuous than the alkyl derivatives of sulphuric acid. Although sulphuric acid is so cheap, and the manufacturing process of continuous etherification has been rendered as perfect perhaps as is possible, still oil of vitriol is unfortunately prone to decomposition in contact with a readily oxidisable substance such as alcohol, becoming reduced to sulphur dioxide which is lost in the gaseous state. Moreover, the powerful affinity of oil of vitriol for water, which is one of the products in the first stage of the reaction, brings about such a dilution after treatment with a considerable quantity of alcohol, that it is no longer capable of performing its function in the process of etherification, which latter must of necessity be arrested in order that the acid may be replaced. Now, the sulphonic acids of the aromatic series, such as benzene sulphonic acid, $C_6H_5.SO_2.OH$, are so stable at the temperature of reaction with alcohol, that the latter is only etherified, and not in the slightest degree oxidised, doubtless owing to the fact that the hydroxyl group present in sulphovinic acid is replaced by the less mobile radicle of the benzene nucleus. Further, the water which gradually accumulates is not retained by the sulphonic acid, but passes over largely with the ether, from which it separates as a distinct layer in the receiver.

This mode of preparation of ethyl ether and its homologues from alcohols by means of sulphonic acids may therefore be very advantageously substituted for the ordinary process now in use. It may be carried on in a perfectly continuous manner, employing the same quantity of the sulphonic acid for weeks, in open vessels and upon any scale. There would appear to be practically no limit to the amount of alcohol which any definite amount of sulphonic acid is capable of converting into ether. Prof. Krafft has actually followed the process with benzene sulphonic acid until one hundred times its weight of alcohol had been so converted, and the residual sulphonic acid appeared as capable of bringing about the reaction, and as free from products of decomposition, as at first.

The reaction in the case of benzene sulphonic acid can readily be proved to occur in the two stages indicated in the following equations:—

$$C_6H_5.SO_2.OH + C_2H_5.OH = C_6H_5.SO_2.OC_2H_5 + H_2O;$$
$$C_6H_5.SO_2.OC_2H_5 + C_2H_5.OH = C_6H_5.SO_2.OH + C_2H_5.O.C_2H_5$$

For if the process is arrested at any time and the liquid in the distilling vessel is poured, when cool, into water, the ethyl ether of benzene sulphonic acid, $C_6H_5.SO_2.OC_2H_5$, immediately separates in the form of a difficultly soluble heavy oil, which after separation is found to boil at 156° under 15 m.m. pressure, which temperature has previously been given by other observers as the boiling-point of the compound.

The benzene sulphonic acid may be replaced by benzene disulphonic acid, para-toluene sulphonic acid, β-naphthalene sulphonic acid, or any stable sulphonic acid or its esters.

As a laboratory or lecture experiment this new process of etherification may be easily carried out in the following manner:—The sulphonic acid, about 80–120 grams in quantity, is conveniently placed in a strong glass tube, 25–30 centimetres high and 5 centimetres wide, closed at one end. The open end is stoppered with a well-fitting ordinary cork bored with three holes, through one of which a thermometer is inserted, through another the tube leading to the condenser, and through the third the stem of a dropping funnel. The benzene sulphonic acid is first melted and then heated to about 135–145° with the thermometer in the liquid. Alcohol is then allowed to emerge into the hot liquid from the dropping funnel, whose stem is made to end in a fine opening only about an inch from the bottom of the reaction cylinder. The supply of alcohol is maintained constant at a convenient rate from a reservoir whose delivery tube passes air-tight through a cork in the neck of the dropping funnel. The two layers of ether and water then rapidly collect in the cooled receiver into which the tube of the condenser passes.

The process lends itself equally well to the preparation of mixed ethers. For instance, if a mixture of methyl and propyl alcohol are allowed to pass through a layer of a sulphonic acid, β-naphthalene sulphonic acid was used in the actual experiment made, at a temperature of 122–126°, the product consists largely of methyl propyl ether. This mixed ether, which has previously been found so difficult to obtain, and which is important as being isomeric with ethyl ether, can readily be obtained pure by fractional distillation of the product, when it is found to boil constantly at 37°. Similarly, di-methyl and di-propyl ether may be readily prepared from the corresponding alcohols. Isobutyl ether may also be obtained with ease from isobutyl alcohol by use of a sulphonic acid, a reaction which it has hitherto not been found possible to carry out by means of sulphuric acid.

A. E. TUTTON.

THE PROGRESS OF TECHNICAL EDUCATION.

SINCE the passing of the Technical Instruction Acts in 1889 and 1891, authorising County Councils to devote the funds accruing under the local taxation (Customs and Excise Act, 1890) to educational purposes, considerable progress has been made both as regards the number of authorities who have availed themselves of the provisions of the Act, and also in respect to the proper disposal of the funds. From the last report of the National Association for the Promotion of Technical and Secondary Education it appears that out of a total of 126 local authorities in England and Wales, 114 are now giving the whole, and twelve are giving part of the grant to educational purposes, and, estimating the total amount distributed at £750,000, no less than £604,000 is spent to this end. These figures show that the work of technical instruction is firmly established, and it only needs to be organised and consolidated to become a very important factor in our educational system.

It seems desirable, now that the scheme has had sufficient time to crystallise into shape, to put on record some of the experiences of Technical Instruction Committees, as set forth in reports to various County Councils. By this means it is possible to give an idea of the developments which are most likely to end in good results. No attempt is made in the following to discuss all the reports, for such a course would be beyond the limits of this paper. A few reports have been selected, and from them extracts have been taken which are likely to be of use for future procedure.

For convenience we begin with the northern counties. The Northumberland Committee reports that—"The average attendance at the science classes was not quite as satisfactory as might have been anticipated. It is notable, moreover, that the centres where the attendance was smallest were not always situated in sparsely populated districts. On the contrary, in more than one fairly populated district, where educational work of a similar character has been carried on for some years, and where a general and ready appreciation of the advantages offered might reasonably be expected, the results were disappointing. In several instances the teachers experienced difficulty on account of the lack or diversity of the previous training of the students, and it is to be hoped that the more general establishment of night schools and continuation classes will, in the course of time, prepare the ground for the work of the special technical instructors."

In thus expressing the need for more schools to prepare the ground for technical instruction, the committee shows its good sense. Elementary science is the best foundation of a technical education, and to attempt to infuse a knowledge of technicalities into the minds of the young mechanics of this country without such a preliminary grounding, is to court failure. The action of the Department of Science and Art, in withdrawing grants for second-class certificates, was taken in order to force the Technical Instruction Committees to provide the necessary elementary instruction. Unfortunately, however, some committees have not yet realised their duty in this matter, so between them and the Department many classes in elementary science have fallen to the ground.

One of the greatest needs experienced by Northumberland is for a good secondary school. To quote the report: "The facilities for secondary education in Northumberland are in certain parts of the county entirely absent, and where they do exist appear to be in many cases inadequate, inefficiently equipped, and having no relation to the established agencies for elementary and higher education. In the south-west of the county there is no secondary school of any description, and the lad who gains a scholarship has no choice between Newcastle and Carlisle. . . . . Of the schools of a secondary character already in existence in the county, in only one or two cases is there any attempt to provide systematic instruction in science, and in no case is there, outside Newcastle, laboratory accommodation for practical work in chemistry or physics."

This is a very regrettable state of things, and much progress cannot be made until it is altered. A good secondary school should be established at every large centre of population. There are, however, numerous large districts not so favoured. For example, the Technical Instruction Committee of the West Riding of Yorkshire, which is without doubt doing as good work as any committee in the country, reports that in the Todmorden district, with a population of over forty thousand, the nearest available secondary schools are at Halifax, more than twelve miles away, and there are many districts in other counties far worse off. Clearly a portion of the sums now spent in the railway fares of holders of scholarships would be better expended in the establishment of secondary schools in the required districts, or by increasing the scholarships to the amount necessary to cover the cost of maintenance of the scholar at a residential college. The payment of the West Riding Committee for railway fares during the year covered by the last report amounted to nearly £4000, of which about £3000 was expended under the scholarship scheme. This money would be better spent in subsidising local technical schools, and the committee intends in the future to follow such a course as far as possible.

It has been remarked that the Department of Science and Art is throwing its responsibility to some extent upon the County Councils. The West Riding Committee estimates that by the withdrawal of grants for apparatus and second-class students, an expenditure of more than £3,500 has been shifted to their Yorkshire Council. It is justly complained that "the changes have been carried out without in any way considering the views of the County Council. It is clearly necessary that some distinct understanding should be arrived at as to the spheres to be respectively occupied by County Councils and the several Government departments, including the Education Department, the Science and Art Department, and the Agricultural Department, or it may be found that the funds specially granted to the County Councils for the purpose of technical instruction are being largely absorbed in carrying out the work hitherto devolving upon Government departments."

To some extent, however, the departments referred to are completely justified in their action. Thus, instruction in elementary science can very well be relegated to local authorities, and so leave the Department of Science and Art to foster more advanced work. This brings us to another point, viz. the system of payment by results. Any other system involves the employment of a large staff of inspectors, and the question then arises as to whether the close inspection required ought to be carried on by the County Councils or by Government officials. It is the opinion of many directors of technical instruction that a Government official is in a better and more independent position for doing such work than a county official. Usually the work of inspection done on behalf of most counties is small. In the case of the West Riding Committee a number of inspectors have been appointed, and the grants made to classes, schools, and institutions under its jurisdiction take the form of capitation grants, depending, not upon the instruction given, nor upon the number and size of the classes at each school or institution, but upon the attendance and work of the individual pupils and students. This admirable system is certainly worthy of extended application.

The Union of Lancashire and Cheshire Institutes has done much to promote primary, secondary, and technical education in Lancashire, Cheshire, and North Derbyshire, and to consolidate the various associations that exist in those counties. The Union acts as an examining board, and offers special prizes and exhibitions for the encouragement of science and art. As evidence of the importance of the Union, and the great activity shown in the cause of technical and secondary education, it is sufficient to say that 128 institutes are affiliated to it, with a membership of over 100,000, and upwards of 80,000 students attending evening classes, and at the examinations held this year 10,700 papers were worked. These facts are enough to indicate that the Union has become an important examining authority in Lancashire and Cheshire. It is satisfactory to know, therefore, that the governing council fully recognises the necessity of good teaching and a thorough systematic scheme of education. It is to some extent owing to the existence of this Union that Lancashire ranks among the counties doing the best educational work. Cumberland and Durham are also developing excellent and comprehensive schemes of instruction.

Passing now to the southern counties, we find that Kent has been largely spending its money upon University Extension Lectures. The following extract from a report of one of the lecturers is therefore of interest:—

"Although the last two years' experience in Kent must have convinced all of the great possibilities of technical education in rural districts, yet at present the success is but partial, and the results ephemeral, owing to the isolation and want of continuity of the various educational ventures in process of trial. To achieve real educational results, local classes under local teachers should be formed in each village centre. Laboratory accommodation of a simple and inexpensive nature should be provided, and from time to time a course of lectures by an experienced lecturer might supplement the local class, and serve to arouse general sympathy, interest, and enthusiasm.

"Most emphatically would I urge, with the whole conviction of past experiences, the absolute necessity for practical laboratory instruction as a part of any scheme for the teaching of chemistry. To make technical education a real servant to the national weal, and a sound branch of educational progress, it will be necessary to connect, systematise, and unify the varied educational machinery employed. The successful founding of village laboratories and classes, under capable instructors, will make it possible for a village lad to place his foot upon the first rung of a ladder that will raise him through urban technical institutes or county colleges to the higher levels of scientific and technical instruction.

"As an extension lecturer, I feel bound to confess that, standing alone face to face with the problem of technical education in rural districts, our present system is doomed to failure unless supported by an adequate system of local teaching, and, as a student of science, I feel convinced of the absolute impossibility of imparting an intelligent group of scientific principles capable of practical application and utility unless such instruction be supplemented by courses of practical and experimental study."

This is a right view to take. The function of the extension lecturer is that of a pioneer in the case of science, whatever it may be with literature. There is no doubt that in the classes held after extension lectures, the lecturer assumes more the part of a teacher by being brought into closer contact with the students, but even then it is doubtful whether he is often regarded as more than a popular exponent of elementary principles.

The Technical Instruction Committee of the Surrey County Council is a very strong one, and its efforts have been attended with a remarkable measure of success. In the tenth report of the committee, however, it is remarked with regard to the science classes: "There is probably no branch of the work more educationally important than this, and in Surrey, as in other counties, it has been found that there is none which meets with more passive opposition from the public, and, perhaps, costs more, in consequence of the entire lack of efficient teachers in the localities themselves." We are afraid that this is very true. That undefinable quantity—the general public—may attend science lectures of which the main features are magic-lantern illustrations, or explosions and pretty experiments; but that is quite a different matter from attending classes requiring close study. We do not for an instant hold that popular science lectures are not productive of good. By their influence the commonality are brought to know something of the poetry of science, and are set thinking about nature's laws and wonders. What we do contend, however, is that such discourses must be regarded as of a recreative character, calculated more to interest and amuse than to give a clear view of the true inwardness of scientific things. The general public wants variety and highly-coloured facts, and a very small proportion indeed are inclined to take upon themselves the drudgery of hard study. Technical Instruction Committees should remember, therefore, that though the attendance at classes may be small in comparison with that at lectures, the students are mostly workers who take up science seriously, and with the full knowledge that many difficulties must be met and overcome. It is upon this class of the community that all schemes of technical instruction depend for their success. As to the second point raised in the above extract, there is little doubt that, in many counties, peripatetic teaching by good teachers, who can be obtained by the payment of a good salary, is preferable to entrusting the instruction to local dabblers in science. This applies chiefly to country districts in which science was almost unheard of before the County Councils began their educational work.

In the last scholarship report of the Surrey Committee, Mr. Macan, the organising secretary, makes a gratuitous remark that can by no means be substantiated. He says: "The subjects which require most attention in the schools appear to be chemistry, heat, and electricity, and masters are reminded that the purely bookish and routine instruction, which serves to gain South Kensington results, is not enough for a scholarship examination." This is a cheap criticism that might well have been omitted. Any teacher who has had experience of the South Kensington examinations knows that great stress is laid upon the practical teaching of the subjects named, and examiners are expressly forbidden to award marks for meaningless phrases such as are given by candidates with mere book knowledge. And we will say further, that any candidate who could pass the elementary examinations in chemistry, heat, or electricity, held by the Department of Science and Art, would come off with flying colours in the scholarship examination of the Surrey County Council. There is not a single question upon these subjects contained in any of the examination papers of the Council but what a departmental examiner at the present time would consider too elementary for South Kensington candidates.

The work of the Berkshire Technical Instruction Committee has been greatly facilitated by the establishment of the University Extension College at Reading. The college possesses good teachers, and, owing to the proximity of Reading to London, and the special relations which the college has to Oxford, the services of specialists can easily be obtained to supplement the teaching of the regular staff. For the sum of about £300 per annum paid to the college, systematic instruction is given to teachers in elementary schools at four centres. The scheme followed provides an excellent graduated course extending over three years, and given by well-qualified instructors. An agricultural department, such as exists at Bangor, Leeds, and Newcastle, has been added to the college, so that it will not be necessary to send students holding agricultural scholarships out of the county for their instruction. The establishment of University Extension colleges at strong centres is certainly an admirable plan, and County Councils would do well to assist in their foundation and adequate equipment.

An important report upon the relation of secondary schools to a county scheme of technical education has been prepared for Southampton county by Mr. Vaughan Cornish, and adopted by the Technical Instruction Committee. The fact is recognised that it is of little use to make provision, by scholarships or otherwise, for the highest forms of technical training unless there are schools which provide such an instruction. Hampshire at present possesses very few schools of this kind, but the committee proposes to assist, by means of capital grants to improve the appliances for teaching, by capitation grants, and by scholarships, the public secondary schools in the county that are able to give an efficient general preparation for an industrial (*i.e.* manufacturing, agricultural, or commercial) career. Something can be said in favour of this scheme, but great care will have to be taken in the selection of the schools, or the funds may be misapplied.

From the report of the Wiltshire Technical Instruction Committee, it appears that that county shows a lower standard of general elementary education than that of almost any county in England. On this account, the majority of the students are not fit recipients of higher or technical education; and the fact that very few technical or secondary schools exist within or in the near neighbourhood of Wiltshire, has rendered the work of the committee most difficult. It has been necessary to create as well as foster a desire for technical education. In this connection the following extract from a letter addressed to Lord Fitzmaurice by Mr. Ashenhurst is of interest:—

"It must be borne in mind that mathematics are the real foundation on which technical knowledge alone can be built up, and I am fully convinced in my own mind that intending students seeking instruction in the different technological subjects, for the teaching to be of any practical use to them, they must of necessity study the above-mentioned subjects. Until such times as classes for the study of the higher branches of arithmetic and mathematics are established, it is almost useless for the committees of different technical schools in the county to expect a large number of students to derive advantage from the various subjects being taught in technology.

"These remarks are based upon the fact that, personally, I have been obliged to teach arithmetic before the students could make the necessary calculations for the branch of textile industry I am now particularly engaged to teach, viz. cloth weaving and designing.

"Had such institutions as the Mechanics and Working Men's Institutes, which have been so prevalent in the large towns and villages of the North for this last thirty or forty years, been established in this district, where evening classes could have been held for instruction in elementary subjects, the educational standard of this county would have held its own with that of any other in the United Kingdom."

But though the committee has had to labour under such difficult conditions, and has made some mistakes (which was inevitable, perhaps, under the circumstances) it has worked energetically and well in initiating and fostering technical education in Wiltshire, and it has evolved a system of instruction that ranks in point of excellence even with that of any northern county.

The real object and scope of technical education is thus stated by the Devon County Council:—

"It is not contended that technical education will prove a panacea for all the evils resulting from the depression of trade and agriculture, or that it will remedy all the difficulties arising from foreign competition. But it is certain, that by due attention and reform in our educational methods, a good deal can be done to remove some of the more serious defects under which our industries are at present carried on.

"Technical education has been described as being not so much a specific subject, or group of subjects, as a *method*. It is concerned with the 'why' and the 'wherefore' and the 'how.' It enables workmen to develop their faculties, to obtain a knowledge of the principles underlying their work, and to get thoroughly practical information with regard to the materials and the tools which they use. It provides a means for the training of the eye and hand, and encourages dexterity, neatness, and order; and while not in any way antagonistic to book learning, it relies to a great extent upon handwork rather than upon headwork. It does not, however, involve the teaching of the practice of a trade or industry, or the drilling of individuals as apprentices would be drilled."

This certainly reads very well, and may be taken as a sign that Devonshire is at last beginning to work on good lines. We notice with some regret, however, that the committee has decided to relegate some of their powers to District Committees. The whole provision of technical instruction is to be in the hands of (1) the County Technical Education Committee; (2) the District Committees, who are responsible to the County Technical Education Committee; and (3) the Local or Parish Committees, who are in turn responsible to the District Committees. The general opinion of those who ought to know is that the system of District Committees or Divisional Committees is a hopeless blunder. Such bodies may be of use for advising purposes, but when money has been allotted to them for distribution, it has generally led to inefficient and extravagant expenditure. It is satisfactory to learn that the instruction in the technical and the science and art schools of Devon is increasing in comprehensiveness, but there is yet much room for improvement. The last report shows that all the schools devote considerable time and energy to art, but few of them take up an adequate number of science subjects.

The committee of the Cheshire County Council does not institute classes, but make grants to various centres to carry out class work. A staff of lecturers is kept engaged in visiting various places, and giving series of lectures on subjects mostly connected with agriculture. Grants are made to grammar schools, and considerable subsidies are given to various bodies for building purposes. In addition to these grants, most of the town councils and local boards in Cheshire tax themselves for technical instruction purposes. The county also possesses a comprehensive scholarship scheme. It seems a pity, however, that the committee does not pay more attention to the teaching of the rudiments of science, instead of concentrating their energies almost entirely upon "bread and cheese" subjects.

Before the Technical Instruction Act came into operation, Shropshire had done very little to foster education of any kind. It is not at all astonishing, therefore, to learn that much of the early work of the Technical Instruction Committee was futile. In 1892 the scheme for agricultural and science scholarships completely failed; six were offered of the former, and ten of the latter, but though the examinations were well advertised, only one candidate entered his name, and he failed to obtain half the total marks adjudged to the papers set. There was also a very limited competition for the exhibitions and scholarships offered this year; indeed, the results have been so unsatisfactory that the committee has rescinded the original scholarship scheme and substituted another. Salop is not alone in this respect, for quite a number of counties have had a difficulty in producing candidates for their scholarships, to their discredit be it said. The committees of these counties will have to work for many years before they bring their charges up to the standard of counties like Yorkshire.

The work of technical instruction carried on in Somerset is based upon broad lines, and is extending. From the outset, however, the task of the committee has been made more difficult by the almost complete absence of fully organised schools of science and art, the absence of any adequate provision for science or technical training in the secondary schools, and the consequent inefficient previous education and training of those who have attended the classes in special technical subjects. It was to be expected in such a case that University Extension lectures should be found a satisfactory means of reaching the adult population, and also of great service in creating an interest

in science and in technical instruction generally. The Somerset committee is laying an excellent foundation on which to erect a permanent and comprehensive system of technical education, but some time must elapse before the structure will be seen and properly appreciated by the county. The following extract shows that the committee realises the importance of instruction in elementary science and mathematics:—

"It is the boys at present at secondary schools who will in time become directors and leaders of industries, agricultural or otherwise, and from whom improvements in our various industries ought to come. The best way to prepare them for their future career, and to equip them for their struggle against foreign competition, is to begin whilst they are still at the secondary schools, and give them a sound general education, including a large proportion of science and mathematics. They will thus learn something of the method of experiment and of the manner in which knowledge is acquired, their powers of observation will be cultivated, and their judgment to some extent trained, and they will learn to see much more clearly than at present the intimate relation between science and their daily life and occupations.

"It seems certain that the only way in which a real appreciation of the value of technical instruction in agriculture can be created is to provide for the coming generation of farmers a sound training of the character indicated. In this connection it may be well to call attention to a statement made by Prof. Fream, in his report on technical education to the Royal Agricultural Society of England, that his own experience, extending over many years, shows that a boy who is 'fairly competent in mathematical studies,' is as a rule very good material to work upon in giving instrucion in the principles and practice of agriculture. To mathematics, from this point of view, natural science may unquestionably be added.

"At present it must be admitted that the science teaching in the secondary schools in Somerset has not reached the degree of excellence and thoroughness that is desirable, and in some instances the teaching of mathematics is capable of considerable improvement. There is at present no school in the county at which higher scholarships under the Technical Instruction Acts could fitly be made tenable."

Staffordshire did excellent work in the cause of technical education before the passing of the Technical Instruction Act, and since then it has taken the initiative in many important developments. Both last year and this, a number of teachers in elementary schools received grants towards the expense of a course of manual instruction in wood-work, metal-work, and cardboard-work at Dr. Götze's institute in Leipzig, and most of them are now conducting classes in the county. This system cannot be too highly commended, and is worthy of adoption by every county; for by it new methods of work will be learnt, while the insularity that characterises the British workmen will be removed.

Like many other counties, Oxfordshire has to lament the want of an adequate number of secondary and technical schools. On this account it has been found difficult to arrange for the further education of holders of county scholarships. Notwithstanding these serious defects, however, the committee reports that, taking the county as a whole, secondary and technical instruction is in a state of increased efficiency. In common with other committees, that of Oxfordshire sent in 1892 a number of teachers to attend the summer courses on geology, chemistry, botany, and mechanics, arranged at Oxford by the delegates for the extension of University teaching, and with most satisfactory results. A similar summer course for County Council students was held this year, the subjects and the lecturers being:—Geology, Prof. A. H. Green, F.R.S.; Practical Physics, Rev. F. J. Smith; Hygiene, Dr. C. H. Wade; Chemistry, Mr. J. E. Marsh; Animal and Vegetable Pests of Crops and Stock, Mr. P. Chalmers Mitchell and Mr. J. B. Farmer. The success of these short courses indicates that it may be desirable for counties to grant scholarships which would enable students to reside in University towns during term, and take advantage of the many facilities for study available at these centres of learning.

No reference has yet been made to the county boroughs. This survey would not be complete, however, without a few words on the work done in some cities. Oxford city, for instance, has a very strong Technical Instruction Committee, and the work accomplished during the last session shows a very considerable advance upon that of the previous year.

The city of Liverpool possesses a scheme of technical instruction that connects educational institutions from the elementary schools up to the University by means of scholarships and free studentships, and is thus a true educational ladder. The technical instruction is controlled by a sub-committee of the Liverpool Library Museum and Arts Committee. Before this sub-committee came into power, much of the work of technical instruction previously carried on in the city was supported by voluntary contributions, but these were largely withdrawn as soon as public money became available for the purpose. Owing to the loss of income due to this cause, and that which has resulted from the withdrawal of grants by the Department of Science and Art, and the City and Guilds of London Institute, a large portion of the funds set apart by the Council for purposes of technical instruction has to be used in supplying these deficiencies. But in spite of this, new branches of work have been developed, and in a very short time the whole scheme of the sub-committee will be in successful operation. A nautical college has been established, and from the last report of the head-master, Mr. James Gill, it appears that an astronomical observatory is to be erected in the school-yard, which will serve to create a greater interest in nautical astronomy and the almanac by reference to the aspects of the heavens, revealed by the telescope, and the astronomical methods of measuring time. For completeness of equipment and suitability for the work of technical and scientific nautical instruction, the college compares favourably with any of the same kind in the world.

The borough of Bootle has the distinction of being the first to take advantage of the Local Taxation Fund for technical instruction. The instruction provided in the borough is of the right kind, and should lead to good results.

The first report of the Technical Instruction Committee of Plymouth shows that progress is being made. That the demand for technical instruction is increasing in this borough is evidenced by the fact that though a fine school was opened last year, the building will have to be extended in order to provide the necessary accommodation for students.

It is beyond the scope of this article to refer to the numerous institutes and schools, such as those of Manchester, Birmingham, Bradford, Bristol, and Bolton, that existed before 1889, and made provision for technical instruction. The towns that possess these old-established educational agencies are necessarily far ahead of those that have only recently had the importance of technical instruction thrust upon them. It will have been gathered from the foregoing description that the greatest need felt by newly-constituted authorities is for technical and secondary schools. Not until this want has been supplied, either by subsidising existing schools or building new ones, can many of the County Councils hope to see the fruits of their labours. The policy of withdrawing grants for elementary instruction in science, recently taken by various examining authorities, has been the means of raising the standard of efficiency in counties where science classes have been held for many years. In some counties, however, the committees have not realised that it is their duty to provide elementary scientific instruction; for they are using their funds almost entirely in supplying instruction in industrial "dodges." On the other hand, it is becoming recognised that science students must possess a more extended knowledge of mathematics than they usually have before any great advance can be made. No unbiassed observer can deny that the progress reported up to now has generally been in the right direction. Mistakes have, of course, been made, but the committees are usually not slow in seeing their failings, and rectifying them. In a few years, when the distrust and suspicion which hampers the work in some counties has been broken down, we shall have the nucleus of a system of education such as exists in Germany, France, and Switzerland, and shall begin to reap the benefits that accrue from it. R. A. GREGORY.

SCIENTIFIC SERIALS.

Bulletin of the New York Mathematical Society, vol. iii. No. 2 (November, 1893, New York).—"Lachlan's Modern Pure Geometry" (pp. 33–36) contains a review, by Prof. F. Morley, of Dr. Lachlan's treatise. It mainly points out what the writer considers to be defects in the author's programme, but closes with the hope, since Dr. Lachlan shows so much power in handling his subject, that he will "throw examination

schedules to the four winds of heaven," and deal argely "with some part of the present outlook as stated in Klein's 'Vergleichende Betrachtungen.'" Prof. Cleveland Abbe gives (pp. 36–38) an analysis of papers on vortices in a compressible and rotating fluid, by Mr. Charles Chree, and trusts that the strictly meteorological work of his new position (at Kew) will tempt him to apply modern mathematical analysis to the winds, the clouds, and the storms of the actual atmosphere. Dr. T. Craig's high estimate of the Traité d'Analyse, by M. Émile Picard, will be seen from the space (pp. 39–66) he devotes to an account of this first volume. The extraordinary developments in the theory of functions, in differential equations, and in certain purely algebraical theories, and the important applications of the results of these developments to geometrical, physical, and astronomical problems, have made such a treatise almost indispensable. Notes and new publications occupy pages 65–72.

THE last volume of the *Memoirs of the St. Petersburg Society of Naturalists* (vol. xxiii.), for the Section of Botany, contains, besides the proceedings of the Society, a number of valuable papers. N. V. Diakonoff gives, under the title "Typical Representatives of the Life-substratum," a summary of his researches into the behaviour of lower fungi in an atmosphere devoid of oxygen. The *Penicillum glaucum* is a typical representative of organisms in which no life is possible without the action of oxygen; while *Mucor stolonifer* may be taken as a representative of organisms in which life is impossible without either the action of oxygen or the presence of a substance capable of fermenting. Prof. N. Tsinger gives a description of the mosses of Tula, of which 134 species are enumerated. M. L. P. Bowdin gives the results of his very interesting experiments upon the breaking out of buds upon cuttings of plants. S. G. Navashin describes and figures a new parasite of the cupsulæ of some mosses, *Tilletia* (?) *sphagni*. N. Alboff gives the results of his five years' exploration of the flora of Abkhazia (on the north-east coast of the Black Sea); his collection numbers no less than 1300 species, and does not confirm the conclusion as to the flora of Caucasia, arrived at by MM. Krasnoff and Kuzeretsoff. S. Navashin gives a very elaborate paper on the Discomycete, *Sclerotinia betulæ*, with several coloured plates. The vegetation of e Zerafshun valley is shortly described by V. Komaroff; and N Ponyatsky criticises Hugo de Vries' method for the analysis of isotonic coefficients.

Bulletin de la Société des Naturalistes de Moscou, 1893 November 1.—On some ecto- and ento-parasites of the Cyclopides, by Dr. W. Schewiakoff. One new species, *Trichophrya cordiformis*, is described, as also the ento-parasitic slimes of the Cyclopides.—Note, by W. Zykoff, on the chorda of *Siredon pisciformis*.—Note on a new skull of *Amynodon*, by Marie Pavlow.—A catalogue of the Coleoptera of Kazan, by L. Krulikovsky: the Noctuæ.—On the evolution of the ocean, by H. Trautschold, being an attempt at tracing the gradual development and modification of salinity in the ocean throughout the earth's history.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 23.—"A certain Class of Generating Functions in the Theory of Numbers," by Major P. A. MacMahon, R.A., F.R.S.

The present investigation arose from my "Memoir on the Compositions of Numbers," recently read before the Royal Society and now in course of publication in the Philosophical Transactions. The main theorem may be stated as folows:—

If $X_1, X_2, \ldots\ldots, X_n$ be linear functions of quantities $x_1, x_2, \ldots\ldots, x_n$ given by the matricular relation

$$(X_1, X_2, \ldots\ldots, X_n) = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{n} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & n3 & a_{nn} \end{pmatrix} (x_1, x_2, \ldots\ldots, x_n),$$

that portion of the algebraic fraction

$$\frac{1}{(1 - s_1X_1)(1 - s_2X_2)\ldots\ldots(1 - s_nX_n)},$$

which is a function of the products,

$$s_1x_1, s_2x_2, \ldots\ldots, s_nx_n,$$

only, is $1/V_n$, where (putting $s_1 = s_2 = \ldots\ldots = s_n = 1$)

$$V^n = (-)_n x_1 x_2 \ldots\ldots, x_n \begin{vmatrix} a_{11} - 1/x_1, & a_{12}, & \cdots & a_{1n} \\ a_{21}, & a_{22} - 1/x_2 & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} - 1/x_n \end{vmatrix}.$$

The theorem is of considerable arithmetical importance, and is also of interest in the algebraical theories of determinants and matrices.

The theory is developed at length in the paper, with illustrative examples of arithmetical applications.

Incidentally interesting results are obtained in the fields of special and general determinant theory. The special determinant, which presents itself for examination, provisionally termed "inversely symmetric," is such that the constituents symmetrically placed in respect to the principal axis have, each pair, a product unity, whilst the constituents on the principal axis itself are all of them equal to unity. The determinant possesses many elegant properties which are of importance to the principal investigation of the paper. The theorems concerning the general determinant are connected entirely with the co-axial minors.

I find that the general determinant of even order, greater than two, is expressible in precisely two ways as an irrational function of its co-axial minors, whilst no determinant of uneven order is so expressible at all.

Of order superior to 3, it is not possible to assume arbitrary values for the determinant itself and all of its co-axial minors. In fact of order n the values assumed must satisfy

$$2^n - n^2 + n - 2$$

conditions, but these conditions beings atisfied, the determinant can be constructed so as to involve $n - 1$ undetermined quantities.

"On the Whirling and Vibration of Shafts." By Stanley Dunkerley, Berkeley Fellow of the Owens College, Manchester.

December 7.—"Reptiles from the Elgin Sandstone: Descriptio of Two New Genera." By E. T. Newton, F.R.S. Com unicated by permission of the Director-General of the Geological Survey.

Two new reptiles from the Elgin Sandstone are described in detail. One of them is the property of Mr. James Grant, of Lossiemouth. The bones themselves being absent, their forms have been reproduced by gutta-percha casts taken from the cavities left in the stone. This reptile was evidently allied to *Stagonolepis*; it is represented by the skull, which is about three inches long, and the anterior half of the body, with the pectoral arch and both the fore limbs. The skull is depressed, has a pair of large prelachrymal fossæ; the two nasal openings are small, and placed near the end of the muzzle. The palate is narrow and deeply grooved, with primitive posterior nares placed far forwards. The vertebræ and limbs are Crocodilian in form. Above the vertebræ there is a double row of pitted, and closely-set scutes. This small Parasuchian is named *Erpetosuchus Granti*.

The second specimen was obtained by the Rev. Dr. Gordon, from the quarry at Spynie. In this fossil the bones were present, and the skull is still preserved, but many of the other bones were too much crumbled to show their form, and the casting process was again resorted to. The neck and fore limbs are wanting. The skull, which closely resembles that of *Ceratosaurus*, is about $4\frac{1}{2}$ inches long, sharp anteriorly, and bird-like when seen from above, but deep when seen from the side, and it has a large prelachrymal fossa. The teeth are compressed and serrated anteriorly and posteriorly. The palate is deep, and a median pair of apertures, near the post-palatine vacuities, are believed to be primitive posterior nares placed far back. Many oval scutes are scattered above the neural spines.

This reptile seems to be intermediate between the Dinosaurians and Crocodilians; the skull and teeth are most like those of Dinosaurs; the pelvis and limbs might belong to either Dinosaurs or Crocodiles; while the free astragalus is certainly a Crocodilian character; provisionally it is referred to the Theropodous Dinosauria, and named *Ornithosuchus Woodwardi*.

"The Organogeny of *Asterina gibbosa*." By E. W. MacBride. Communicated by Adam Sedgwick, F.R.S.

"On Copper Electrolysis *in Vacuo*." By William Gannon.

"Note on the Action of Copper Sulphate and Sulphuric Acid on Metallic Copper." By Prof. Arthur Schuster, F.R.S.

Physical Society, December 8.—Prof. A. W. Rücker, F.R.S., President, in the chair.—A paper, by Mr. James Swinburne, on a potentiometer for alternating currents, was read by Mr. Blakesley. After referring to the many advantages of the "potentiometer" method of measurement, the author describes an arrangement by which alternating pressures can be measured. A quadrant electrometer with a double fishtail-shaped needle suspended by a torsionless fibre is employed. The electrostatic attraction exerted by an alternating pressure between the needle and one pair of quadrants is balanced by the force due to a steady pressure between the needle and the other pair of quadrants. The magnitude of the steady pressure is determined by a potentiometer and standard cell, and the effective value of the alternating pressure thus deduced. For measuring alternating currents a differential electrodynamometer having two fixed coils and one moving coil, and no controlling spring, is used. A direct current, measured by the fall of potential over a small resistance, is passed through one of the fixed coils, the alternating current through the other fixed coil, and the moving coil is included in both alternating and direct current circuits. When the two forces balance, the currents are taken as equal. Several small inaccuracies to which the method is subject are mentioned in the paper. Prof. S. P. Thompson inquired if the fishtail-shaped needle of the electrometer was novel. Mr. Blakesley said the author had mentioned the needle previously. He (Mr. Blakesley) thought the name "potentiometer" was not very suitable. In effect, the so-called measurement of *pressures* was a comparison of two *powers*.—The President announced that Mr. Preece's note on the specific resistance of sea-water had been temporarily withdrawn.—Prof. G. M. Minchin made a communication on the calculation of the coefficient of self-induction of a circular current of given aperture and cross-section. Instead of assuming the cross-section of the wire small, and the current density constant over the section, as is usually done, the author takes into account the dimensions of the section and the non-uniform distribution of the current. Making use of the expressions for the vector potential (G) of the current given in his previous papers (*Phil. Mag.* April and August, 1893), the author calculates the total normal flux of force through a surface intersected once in the positive direction by every tube of force emanating from the given current. This flux, divided by the current, gives the coefficient of self-induction. The surface chosen is the circular aperture of the current and half of the anchor ring formed by the wire. When the current density is inversely proportional to the distance from the axis of the circular current, the value of the coefficient of self-induction is found to be

$$\pi\left\{4a(L-2)+2c\left(L-\frac{5}{4}\right)-\frac{c^2}{16a}(2L+19)\right\},$$

where a is the radius of the central filament of the current, c the radius of the cross-section of the wire, and $L = \log\frac{8a}{c}$. Clerk-Maxwell's approximate expression agrees with this in the principal term. As an example of the closeness of the approximation, the case of a current in a wire 2 millimetres diameter bent to a circle of 2 centimetres mean diameter had been taken, the approximate and corrected coefficients being 58·866 and 59·207 absolute units respectively. When the current in the wire is superficial, as in case of alternating currents of high frequency, the coefficient is somewhat greater, being given by the expression

$$\pi\left\{4a(L-2)+2c\left(L+\frac{3}{2}\right)+\frac{c^2}{16a}(4L+11)\right\}.$$

Incidentally it was pointed out that the function Gx where G is the vector potential at a point distance x from the axis of a circular current was the same as Stoke's *current function* in hydrodynamics. Another paper, on the magnetic field of a current running in a cylindrical coil, was read by Prof. Minchin. The cylindrical coil is regarded as a series of equal circles lying close together and forming a cylindrical surface. Replacing each circular current by its equivalent magnetic shell, the problem of finding the magnetic potential at a point resolves itself into calculating the gravitational potential due to two circular plates of attracting matter, one positive and the other negative, situated respectively at opposite ends of the cylinder. The magnetic potential due to one plate is then deduced in terms of elliptic integrals of the first, second, and third kinds. The President had pointed out that the expressions given in the printed proof of the paper, only applied when the perpendicular from the point to the plate fell within the circle; the author had therefore modified the formula so as to be true generally. From this formula the equipotential curves can be constructed. The same system of curves serve for the plate at the other end of the cylinder by changing the signs of the numerals representing the potentials and giving the curves a motion of translation equal to the length of the cylinder in the direction of its axis. The equipotential curves for the coil can then be deduced by drawing through the points of intersection of the two sets of curves whose numerical values have a constant sum. In determining the curves the author had to calculate tables of elliptic integrals of the third kind, and these he hoped to complete before the paper was published. In reply to a question on the first paper, which had been brought before him by Prof. Perry, the author said that as the diameter of the wire diminished indefinitely, both the self-induction and resistance became infinite, but the ratio L/R became zero. It was interesting to examine what relation betwen the aperture and cross-section gave minimum impedance. If the ordinary expression for it be taken the problem was impossible, but the corrected form admitted of a solution. Prof. Perry hoped the work Prof. Minchin had done so well for circles and cylinders would be extended to cylindrical coils of rectangular cross-section. It was most important to be able to find the shape of the field produced by such coils. Prof. S. P. Thompson inquired if there was any way of deducing the expression for the magnetic force at a point other than that given in the paper on the magnetic field of a circular current (*Phil. Mag.* April, 1893). In reply Prof. Minchin explained how the formula followed at once from the fundamental theorem that magnetic force is the curl of the vector potential. This was based on Laplace's expression for the force between a magnetic pole and an element of current which had been proved experimentally.

Zoological Society, December 5.—W. T. Blanford, F.R.S., Vice-President, in the chair.—The secretary read a report on the additions that had been made to the Society's menagerie during the month of November. Among these special attention was called to a Cunning Bassaris (*Bassaris astuta*), obtained by purchase, to two Jerboas presented by Capt. R. A. Ogilby, and to a fine adult female of the Caucasian Wild Goat (*Capra caucasica*), presented by H. H. P. Deasy.—Prof. G. B. Howes exhibited and made remarks on some specimens of abnormal Marsipobranch Fishes. These were two heads of the Lamprey with the first pair of gills only imperfectly developed, and a Hag (*Myxine glutinosa*) with a supernumerary gill on one side.—Mr. F. E. Beddard, F.R.S., gave an account of the general geographical distribution of Earthworms, as treated of in a work on the subject which he had in preparation. Mr. Beddard recognised sixty-nine genera of this order, divided into six families; and after some preliminary remarks on the artificial introduction of earthworms into districts colonised from Europe, called attention to a series of tables in which the genera found in the six generally recognised regions of the earth's surface were shown. In addition to these six regions Mr. Beddard was disposed to recognise, in the case of earthworms, the existence of an Antarctic region, to embrace New Zealand and most of the Antarctic Islands.—A communication was read from Mr. C. J. Gahan, containing an account of a collection of Coleoptera sent by Mr. H. H. Johnston, C.B., from British Central Africa. Amongst these were examples of eight species new to science.—A communication was read from Capt. F. W. Hutton, F.R.S., containing a report on a collection of Petrels from the Kermadec Islands. Amongst them was an example of a new species proposed to be called *Œstrelata leucophrys*.—Mr. G. A. Boulenger gave an account of *Vipera renardi*, a newly recognised European Viper from Southern Russia and Turkestan.

Entomological Society, December 6.—Henry John Elwes, President, in the chair.—Mr. W. F. Kirby exhibited, for Dr. Livett, specimens of a moth taken at Wells, which Dr. Livett considered to be varieties of *Dasycampa rubiginea*, but which many entomologists present thought were varieties of *Cerastis vaccinii*. Mr. Kirby stated that specimens similar in appearance

to those exhibited had been taken rather freely during the past autumn in Berkshire, and it was suggested that they might be hybrids between *D. rubiginea* and *C. vaccinii*.—Mr. Lovell-Keays exhibited a series of *Lycæna alexis*, with confluent spots on the under sides of the front wings. He drew attention to the fact that the insects were all taken within a short radius, and probably were in the ratio of about one in forty with reference to the ordinary form. All the examples, with one exception, were females. Mr. Lovell-Keays remarked that he had some years ago met with a similar brood near Weymouth, in which the confluent spots were entirely confined to females. Prof. S. H. Scudder, of Cambridge, Mass., U.S.A., stated that he had observed the occurrence of broods of allied species with suffused spots in America.—Mr. C. O. Waterhouse exhibited the type specimen of *Coptomia opalina* of Gory, from the Hope Collection at Oxford, and pointed out that it was quite distinct from *C. mutabilis*, W. Mr. Waterhouse also called attention to *Silpha atomaria* of Linnæus (Syst. Nat., ed. xii., i., p. 574), a Swedish species which appeared to have escaped notice, and was not included in any catalogue. The type is still extant in the Linnean cabinet, and he said he was of opinion that it was *Olibrus geminus* of our collections, but he had not had an opportunity of making a critical examination. He also exhibited male and female specimens of a *Helopeltis* (the Tea-Bug), which he considered a distinct species, occurring only in Assam.—Mr. M. Jacoby exhibited certain species and varieties of the genus *Ceroglossus* from Chili, and Dr. D. Sharp, Mr. J. J. Walker, and Mr. Champion made remarks on their geographical distribution.—Prof. Scudder exhibited the type specimen of a fossil butterfly, *Prodryas persephone*, found in beds of Tertiary Age at Florissant, Colorado. He said the species belonged to the *Nymphalidæ*, and the specimen was remarkable as being in more perfect condition than any of those from the European Tertiaries. He also stated that he had found a bed near the White River on the borders of Utah, in which insects were even more abundant than in the Florissant beds. Dr. Sharp, Mr. Kirby, Mr. H. Goss, and the President took part in the discussion which ensued.—Mr. Goss exhibited hybernating larvæ of *Spilothyrus alceæ*, which had been sent to him by Mr. F. Bromilow from St. Maurice, Nice. Mr. W. F. H. Blandford read a paper entitled "The Rhynchophorous Coleoptera of Japan." The President, Dr. Sharp, Mr. Champion, Mr. McLachlan, and Mr. J. J. Walker took part in the discussion which ensued concerning the distribution of the group and the admixture of Palæarctic and Oriental forms. —Mr. G. T. Bethune-Baker read a paper entitled "Notes on some Lepidoptera received from the neighbourhood of Alexandria," and exhibited the specimens described. Mr. McLachlan suggested that the scarcity of insects in Egypt was possibly to be accounted for by the fact that much of the country was under water for a considerable portion of the year; and Dr. Sharp said that another cause of the scarcity was the cultivation of every available piece of land for centuries past.—Mr. C. O. Waterhouse read a paper entitled "Further Observations on the Tea-Bugs (*Helopeltis*) of India."—Dr. F. A. Dixey communicated a paper entitled "On the Phylogeny of the *Pierinæ*, as illustrated by their wing-markings and geographical distribution."

Geological Society, December 6.—W. H. Hudleston, F.R.S., President, in the chair. The following communications were read:—The Purbeck beds of the Vale of Wardour, by the Rev. W. R. Andrews and Mr. A. J. Jukes-Browne. The authors have obtained better evidence than previously existed for calculating the thicknesses of the several parts of the Purbeck series in the Vale of Wardour, and compared the different subdivisions as developed in that vale with those exposed in other localities. The average thickness of the Lower Purbeck strata was given as 70 feet, of the Middle Purbeck beds about 32 feet, and of Upper Purbeck strata at least 66 feet. A comparison was instituted between the Purbeck beds of the Vale of Wardour and those of the Dorset coast, &c., and some remarks were made upon the physical conditions under which the beds were deposited. A discussion followed, in which the President, Prof. J. F. Blake, Prof. T. Rupert Jones, and Mr. H. B. Woodward took part. The Rev. W. R. Andrews briefly replied.—On a picrite and other associated rocks at Barnton, near Edinburgh, by Mr. Horace W. Monckton. The object of this paper was to describe a cutting on a new railway in Barnton Park, where there is an excellent exposure of picrite. It consists of serpentinised olivine, augite, mica, iron oxide, and a little plagioclase-felspar, with a variable amount of insterstitial matter. In many respects it comes very near to the picrite of Inchcolm, which island is $4\frac{1}{2}$ miles north of Barnton cutting. It differs from the picrite of Bathgate, and the probability is that the Barnton rock is an offshoot from the same magma as that which supplied the Inchcolm rock. Besides the picrite other igneous rocks from the same cutting were described—in particular, a rock with porphyritic crystals of a green mineral replacing olivine, or more probably augite, and a great quantity of brown mica in small flakes and crystals. It was suggested that the name of mica-porphyrite might be given to this rock. Sir James Maitland made some remarks upon the paper.—On a variety of *Ammonites* (*Stephanoceras*) *subarmatus*, young, from the Upper Lias of Whitby, by the same author. The author described an ammonite found by himself in 1874 near Sandsend, three miles north-west of Whitby. He thought it was not actually *in situ*, but lying with a number of nodules on the floor of an old alum-pit, although he had no doubt that it was from the alum shale of the Upper Lias. A peculiar arrangement of the costæ as they cross the siphonal area distinguishes the specimen from other Whitby ammonites known to the author. It bears a strong resemblance to a shell figured as *A. subarmatus* by D'Orbigny ("Terr. Jurass." pl. lxxvii.), but is unlike the figures of that species given by other authors.

Linnean Society, December 7.—Prof. Stewart, President, in the chair.—Mr. C. T. Druery exhibited and made remarks upon a new example of apospory in *Scolopendrium vulgare*, and Prof. Bower brought forward a similar case in *Trichomanes Kaulfussii*. Mr. George Brebner exhibited some new and rare British Algæ, including *Haplospora globosa*, *Tilopteris Mertensii*, *Ectocarpus tomentosoides*, and *Polysiphonia spinulosa* var. *major*. Mr. F. Enoch, with the aid of the oxyhydrogen lantern, exhibited the various stages of development of the black currant mite, *Phytoptus ribis*, and gave an interesting account of its life history.—Mr. Thomas Christy exhibited a gigantic reed-like leaf from the Zambesi, with drawings of sections. It appeared to be allied to *Sansevieria cylindrica*, but differed conspicuously in the greater size of the leaves, which measured about 9 feet in length, instead of from 18 inches to 3 feet. The remarkably tough and strong fibre which it produces is considered to be of great commercial value, being equal to the best Sansevieria hemp.—Mr. W. F. Kirby read a paper on the dragon-flies of Ceylon, with descriptions of some new species. The paper was based chiefly upon a collection made by Colonel Yerbury, which he had presented to the British Museum. Seventy-five species were enumerated, of which fifty-five had been collected by Colonel Yerbury. Another collection, made in Ceylon by Mr. E. Green, had been dealt with in a previous paper (*Proc. Zool. Soc.* 1891, pp. 203-206).—On behalf of Signor Martelli, the secretary read a paper on the cause of the fall of the corolla in *Verbascum*, which gave rise to an interesting discussion. The meeting adjourned to December 21.

PARIS.

Academy of Sciences, December 11.—M. de Lacaze-Duthiers in the chair.—On the sublimation of the red and yellow iodides of mercury, by M. Berthelot.—Research on the structure of feathers, by M. C. Sappey.—The densities of saturated vapours, and their relation to the laws of condensation and vaporisation of the solvents, by M. F. M. Raoult.—On the burning of moor and forest lands in Gironde, and the exceptional drought during the spring and summer of this year, by MM. G. Rayet and G. Clavel. The long drought of the spring and summer of this year has favoured the production and extension of fires in the pine woods of the department of Gironde. In the 184 days between March 1 and September 1, 132 fires happened in the woods of Gironde, destroying 35,589 hectares of forest land, and doing damage to the extent of six million francs. Similar disasters occurred in 1870, and they have led the authors to look up the rainfall observations for the last 122 years for purposes of comparison. Among other points brought out by the investigation is that only two springs, 1716 and 1768, were drier than that of 1893. The summer of this year, however, only ranked thirteenth in order of dryness. —Solar observations made during the second and third quarters of 1893, by Prof. Tacchini (see Our Astronomical Column).—On the surfaces of which the lines of curvature of a system are plane and equal, by R. T. Caronnet.—On the characters of convergence of series, by M. Hadamard.—Low wave-length

spectrum of fluorine, by M. G. Carvallo.—On the diurnal variation of pressure on the summit of Mont Blanc, by M. A. Angot.—On the transformation of iron, by M. G. Charpy. Osmond's investigations of the transformations of iron led him to conclude that this metal exists in two allotropic forms, α and β, having very different mechanical properties, and, according to him, it is to the transformation of α into β that we must attribute the greater part of the modification undergone by steel during the process of tempering. M. Charpy has investigated the matter, and he finds that permanent deformation by cooling produces in iron and steel of different qualities an allotropic modification of iron. This transformation can be shown by means of curves of extension-tests. In the case of annealed iron and steel the curve showing the stress and strain has a step in it which does not appear when other varieties are tested. The curves thus furnish a simple method of studying the transformation of iron, its influence on mechanical properties, and its *rôle* in tempering.—On the velocities of etherification of hydrofluoric acid, by M. M. Meslans.—Analysis of butters, by M. C. Viollette.—On the buccal armature and a new digestive gland of Cirripedes, by M. A. Gruvel.—On the localisation of the active principles in resedas, by M. L. Guignard.—On the olivine of Maillargues, near Allanche (Cantal), by M. F. Gonnard.—Eruption of the Calbuco volcano, by M. A. E. Noguès (see Notes).—On *Benettites Morierei*, a fossil fruit presenting a new type of gymnosperm inflorescence, by M. O. Lignier.—Employment of artificial cultures of pathogenic microbes in the destruction of troublesome rodents, by M. J. Dampz.

AMSTERDAM.

Royal Academy of Sciences, November 25.—Prof. van de Sande Bakhuyzen in the chair.—Prof. J. A. C. Oudemans read a paper on the accuracy of the divisions of the altazimuth made by Pistor and Martin, and that by Repsold, for the triangulation of Java. In Pistor and Martin's circles, divided into 5′, the intervals were alternatively larger and smaller in one instance, the difference in an instrument constructed in 1856 being almost = 6″; in the other instruments it was much smaller. In Repsold's circles, divided into 4′, no difference was found. The discovery of this imperfection led to a severe examination of all the circles, and the result was that, taking into account this difference, and measuring the intervals of seven degrees of each circle from three to five times, it was found that Pistor and Martin's divisions had grown better and better, so that *within one degree*, the mean error of each line, in the instruments of 1865 and 1867, in linear measure, was only $\frac{1}{9}\mu = \frac{1}{230000}$ of an inch. Two altazimuths of Repsold gave $\frac{1}{22}\mu = \frac{1}{559000}$ of an inch. Account was taken of the errors in the measurement of the intervals by the micrometers of the microscopes. The periodic and irregular errors were, of course, larger.—Prof. Zaaijer read a paper on the sutura condylo squamosa of the occipital bone of man and mammalia. For the first time in 1878 attention was directed to this suture (only part of which remained, and that very rarely, with man) by Dr. W. Dominicus who had found this anomaly on some skulls in the collection of the Anatomical Museum at Leyden. However, this observation remained buried in the dissertation of Dr. Dominicus ("Ontleed kundige aanteekeningen betreffende het achterhoofdsbeen." Leiden, 1878). Last winter Prof. Zaaijer quite accidentally lighted on a human skull (from a grave on the island Disko, Greenland) of which the above-mentioned suture was not obliterated. This induced him to examine the state of the sutura condylo-squamosa of mammalia. By the kindness of the Director of the Museum of Natural History at Leyden, about 1900 skulls of mammalia were examined. The chief result of the examination of the skulls of full-grown animals indicated that the suture was found in its entire state with Marsupialia in 8·6 per cent. of the examined skulls (35 in number), Rodentia 3·9 per cent. (155), Pachydermata 16·5 per cent. (85), Ruminantia 10·5 per cent. (210), Simiæ 1 per cent. (202). With the skulls of the adult animals from the other classes the suture was never found in its entire state, no more than with man. Before communicating these results Prof. Zaaijer gave a short description of the normal development of the occipital bone in man. A minute and close investigation of a great number of human skulls raises the question as to whether the entire obliteration of this suture may not be found more frequently with the so-called lower races.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Dynamos, Alternators, and Transformers: G. Kapp (Biggs).—Electric Traction on Railways and Tramways: A. Reckenzaun (Biggs).—Portative Electricity: J. T. Niblett (Biggs).—The Design of Alternate-Current Transformers: R. W. Weekes (Biggs).—Electrical Distribution, its Theory and Practice, Part 1, M. H. Kilgour; Part 2, H. Swan and C. H. W. Biggs (Biggs).—Town Councillor's Hand-book to Electric Lighting: N. S. Russell (Biggs).—First Principles of Electrical Engineering, new edition: C. H. W. Biggs (Biggs).—Descriptive Catalogue of the Anatomical and Pathological Specimens in the Museum of the Royal College of Surgeons of Edinburgh, Vol. 1, the Skeleton and Organs of Motion: C. W. Cathcart (Edinburgh, Thin).—Romance of the Insect World: L. N. Badenoch (Macmillan).—Elementary Lessons in Steam Machinery and the Marine Steam Engine, new edition: J. Langmaid and H. Gaisford (Macmillan).—A Text-book of the Physiological Chemistry of the Animal Body, Vol. 2, the Physiological Chemistry of Design: Dr. A. Gamgee (Macmillan).—Meteorology: H. N. Dickson (Methuen).—Le Cuivre: P. Weiss (Paris, Baillière).—Key to Lock's Shilling Arithmetic: H. Carr (Macmillan).—About Orchids: F. Boyle (Chapman and Hall).—Annals of British Geology, 1892: J. F. Blake (Dulau).—The Flora of the Assyrian Monuments and its Outcomes: Dr. E. Bonavia (Constable).—The Cliff Dwellers of the Mesa Verde, South-Western Colorado: G. Nordenskiöld, translated by D. Lloyd Morgan (Stockholm, Norstedt).—Index Kewensis, Part 2: J. D. Hooker and B. D. Jackson (Oxford, Clarendon Press).—The Royal Natural History, edited by R. Lydekker, Vol. i. Part 2 (Warne).—Random Recollections of Woodland, Fen, and Hill: J. W. Tutt (Sonnenschein).—Imperial University of Japan, Calendar for the Year 1892–3 (Tokyo).—Les Emules de Darwin, 2 vols.: A. de Quatrefages (Paris, Alcan).

PAMPHLETS.—Report of a Conference on Secondary Education in England (Oxford, Clarendon Press).—Official Catalogue of Exhibits and Descriptive Catalogue World's Columbian Exposition, Department M, Anthropological Building (Chicago).—Memoranda of the Origin, Plan, and Results of the Field and other Experiments at Rothamsted.—Report of an Investigation on the Gases enclosed in Coal and Coal Dust: W. McConnell.

SERIALS.—Journal of the Chemical Society, December (Gurney and Jackson).—American Meteorological Journal, December (Ginn).—Bulletin from the Laboratories of Natural History of the State University of Iowa, Vol. 2, No 4 (Iowa).—Mémoires de la Société de Physique et d'Histoire Naturelle de Genève, Tome xxxi., Seconde Partie (Genève).—American Journal of Science, December (New Haven).—Mineralogical Magazine, November (Simpkin).—Materials for a Flora of the Malayan Peninsula, No. 5, Dr. J. King (Calcutta).—Materials for a Flora of the Malayan Peninsula. Index and Title Page to the Thalamifloræ (Nos. 1 to 5 of the Series): Dr. G. King (Calcutta).—Johns Hopkins University, Studies in Historical and Political Science, Eleventh Series, xi.-xii. (Baltimore).—Beiträge zur Biologie der Pflanzen, vi. Band, iii. Heft (Williams and Norgate).—Morphologisches Jahrbuch, 20 Band, 4 Heft (Williams and Norgate).

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